Case-by-Case MACT Analysis

Texas GulfLink Project

Proposed Deepwater Loading Port Facility

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PREPARED FOR:

Texas GulfLink

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1.0 Introduction

Texas GulfLink is applying for a license to own, construct, and operate a deepwater port crude oil export facility pursuant to the Deepwater Port Act ("DPA") of 1974. 33 U.S.C. § 1503. On May 30, 2019, Texas GulfLink submitted its DWP license application to the Maritime Administration ("MARAD") and U.S. Coast Guard ("USCG").[1] Standards promulgated pursuant to Section 112(g) of the Clean Air Act Amendments of 1990 ("CAA") regulate constructed (i.e., new) and reconstructed major sources of hazardous air pollutants ("HAPs") and consist of five standards under Title 40 of the Code of Federal Regulations ("40 CFR") Part 63, §63.40 through §63.44. Section 63.43 requires that an application for a case-by-case Maximum Achievable Control Technology ("MACT") determination be submitted to the permitting authority as part of the pre-construction permitting process. This document serves as Texas GulfLink's 112(g) case-by-case MACT analysis and application for the proposed deepwater port facility.

1.1 Project Background

The Texas GulfLink Project ("Project") is a proposed deepwater port crude oil export facility to be located approximately 28.3 nautical miles offshore of the Texas coast near Freeport, Brazoria County, Texas. The proposed facility location is indicated on the Project Area Map included as Figure 1.

This Project will provide critical infrastructure to the Houston port market for the export of crude oil volumes generated in Texas and Midcontinent oilfields. As United States crude oil exports continue to increase, expanding critical infrastructure along the Gulf Coast will be necessary to provide an efficient and safe solution for large-scale petroleum exporting to international markets. Once completed, Texas GulfLink will be capable of fully loading deep-draft, Very Large Crude Carrier ("VLCC") vessels, Suezmax, Aframax, and Handy Tankers ("other crude tankers") for exporting crude oil to international markets.

[1] Cooperating agencies, such as the EPA, also have parallel adjacent approvals on areas such as air quality, water discharge, and emissions. Cooperating agencies have a memorandum of understanding ("MOU") with the United States Coast Guard to assist in the National Environmental Policy Act of 1969 ("NEPA") review of proposed deepwater ports.

1.2 Project Description

Texas GulfLink's proposed deepwater port consists of the following asset components, listed in order from upstream to downstream (and described in more detail below):

- Incoming 36'' crude pipeline
- 8.5. MM bbl onshore crude oil storage terminal
- Onshore control room and five (5) 5,000 horsepower electric crude oil pumps
- Three (3) 2,000 hp electric crude oil booster pumps
- Departing 42'' crude pipeline
- Offshore manned platform
- Two subsea pipelines
- Two subsea pipeline end manifolds ("PLEMs")
- Two subsea hoses
- Two (2) Catenary Anchor Leg Mooring ("CALM") Single Point Mooring ("SPM") buoys
- Two floating hoses

Texas GulfLink plans to receive crude oil via an onshore crude pipeline and store it in above-ground crude oil storage tanks located at an onshore bulk storage terminal. Upon nomination from the crude oil shipper, the oil will be transported to one of two floating SPM buoys in the Gulf of Mexico, located approximately 28.3 nautical miles offshore, via a 42-inch pipeline. The SPM buoys will allow for VLCC vessels and other crude tankers to moor and receive up to 2 million barrels of crude oil each to be transported internationally. A manned offshore platform will be equipped with round-the-clock port monitoring by radar and visual means, custody transfer metering, early detection of minor drip leaks for advanced warnings, surge relief, and emergency and environmental response capabilities. The platform is necessary not for crude oil loading operations but rather to provide assurance that shippers' commercial risks are mitigated and that the deepwater port facility is protected from security threats and potential environmental risks. Inclusion of a manned platform adds significant cost to the Texas GulfLink Project but it provides benefits that SPM-only projects cannot offer.

The deepwater port onshore project components will consist of the following:

- Newly-installed 9.45 miles of 36” pipeline from the Department of Energy (“DOE”) facility at Bryan Mound to the proposed Texas GulfLink Jones Creek Crude Storage Terminal in Brazoria County, Texas (“Jones Creek Crude Storage Terminal”).
- The proposed Jones Creek Crude Storage Terminal will be located on approximately 200 acres of land and consists of twelve (12) above-ground domed external floating roof (“DEFR”) storage tanks, with a site-wide maximum storage capacity of approximately 8.5 million barrels of “sweet” crude oil, defined as crude with less than 24 parts per million (“ppm”) of hydrogen sulfide (“H_2S”) in the liquid.
- The Jones Creek Crude Storage Terminal will also include:
  - Onshore control room
  - Five (5) 5,000 hp electric mainline crude oil pumps
  - Three (3) 2,000 hp electric crude oil booster pumps
  - One (1) crude oil pipeline pig launcher
  - One (1) crude oil pipeline pig receiver
  - Two (2) measurement skids for measuring crude oil – one (1) skid located at the incoming pipeline from the Bryan Mound facility and one (1) skid installed for the outgoing crude oil barrels leaving the tank storage to be loaded onto the VLCC or other crude tankers
  - Ancillary facilities, to include an operations control center, electrical substation, offices, and warehouse building.

The deepwater port offshore facility will consist of the following assets:

- One 42-inch outside diameter, 28.3 nautical mile-long, crude oil pipeline linking the Jones Creek Crude Oil Terminal to the Texas GulfLink Deepwater Port.

- One fixed offshore platform structure, with 4 piles, located in the Galveston Outer Continental Shelf lease block 423 approximately 28.3 nautical miles off the coast of Brazoria County, Texas, in a water depth of approximately 104 feet. The fixed platform will be constructed with three decks, and will include generators, pig receivers, an lease automatic custody transfer (“LACT”) unit, an oil displacement prover loop, living quarters, an electrical and instrumentation building, portal cranes, a helideck, and a vessel traffic control room utilizing a state-of-the-art radar system. No essential crude oil loading operations occur at the platform.

- The deepwater port will utilize two (2) SPM buoys, each having:
  - Two (2) 24-inch inside diameter crude oil subsea riser hoses interconnecting with the crude oil pipeline end manifold PLEM located on the sea floor. The subsea riser hoses will be approximately 160 feet in length and rated for 275 psig (18.9 bar)
  - Two (2) 24-inch inside diameter floating crude oil hoses that connect the moored VLCC or other crude oil tankers to the SPM buoy for loading. The floating hoses will be approximately 1,000 feet in length and rated for 275 psig (18.9 bar). Each floating hose will contain an additional 100 feet of 16-inch “rail tail hose” designed to be lifted and robust enough for hanging over the edge railing of the VLCC or other crude oil tankers.
- Two (2) PLEMs will provide the interconnection between the pipelines from the offshore platform and the SPM buoys. Each SPM buoy will have one (1) PLEM for crude oil export. Each crude oil loading PLEM will be supplied with crude oil by one (1) 42-inch outside diameter pipeline, each approximately 1.25 nautical miles in length.

Figure 2 shows a profile view of the overall design and equipment layout of Texas GulfLink’s proposed deepwater port facility.

1.3 Project Area

The proposed Texas GulfLink deepwater port facility will be located approximately 28.3 nautical miles offshore from the coast of Brazoria County, southwest of Freeport, Texas. As shown on Figure 1, The platform will be in located Block GA 423 at coordinates 28°33.1’ N 095-01.7W, 3.5 nm west of the existing Freeport Harbor Safety Fairway and 10nm south of the existing East-West Aransas Pass to Calcasieu Pass Safety Fairway. The Safety Zone will be located in blocks GA 423 and GA A 36 and covers an area of 23nm^2. The Safety Zone is a federal regulated area with access restricted. The deepwater port will follow a “Safe-Port-Design” concept for unprotected waters, having a dedicated, buoy marked, Safety Zone providing safe maneuvering distance between the platform and SPM.

1.4 Procedural Requirements for a Case-by-Case MACT Determination

The EPA has allowed Texas GulfLink to submit its case-by-case analysis to propose a MACT emission limit, if applicable, or an appropriate alternate emission control standard because the proposed deepwater port is a new major source of HAPs and not specifically regulated or exempted from regulation under a standard issued pursuant to Sections 112(d), 112(h), or 112(j) of the CAA that has been incorporated in another subpart of Part 63.

The requirements for a 112(g) case-by-case MACT analysis are described in 40 CFR §63.43(e). Under that section, an application for a MACT determination must specify a control technology selected by the owner or operator that, if properly operated and maintained, will meet the MACT emission limit or standard as proposed by the applicant and approved by the EPA according to the principles set forth in 40 CFR §63.43(d).

For a new source, MACT is defined as the emission limitation that is not less stringent than that achieved in practice by the best controlled similar source and that reflects the maximum degree of reduction in emissions that is achievable by the constructed or reconstructed major source. In accordance with §63.43(d)(3), the MACT standard may be determined to be a specific design, equipment, work practice, or operational standard, or a combination thereof, if it is not feasible to prescribe or enforce an emission limitation.

Table 1-1 lists the information that is required to be submitted in a case-by-case MACT analysis, to the extent needed to support a proposed MACT emission limit or standard. Table 1-1 also shows the location where such information is provided on behalf of Texas GulfLink in support of this Project.

In addition to the 112(g) case-by-case MACT requirements, §63.43(c)(4) specifies that Texas GulfLink must comply with all applicable requirements of Subpart A of 40 CFR Part 63 with respect to operation of the deepwater port facility.

Table 1-1 Information Requirements to Support a Case-by-Case MACT Determination as Described in 40 CFR §63.43(e)(2)

Application Requirement	Location of Requirement Content
(i) The name and address of the major source	PSD Permit Application
(ii) A brief description of the major source and identification of any listed source category or categories in which it is included	PSD Permit Application and this MACT Analysis
(iii) The expected commencement date for the construction	PSD Permit Application
(iv) The expected completion date for construction	PSD Permit Application
(v) The anticipated date of start-up	PSD Permit Application
(vi) The HAP(s) emitted by the source and the estimated emission rate for each such HAP	PSD Permit Application and this MACT Analysis
(vii) Any federally enforceable emission limitations applicable to the constructed major source	PSD Permit Application and this MACT Analysis
(viii) The maximum and expected utilization of the source and the associated uncontrolled emission rates for that source	PSD Permit Application and this MACT Analysis
(ix) The controlled emissions for the source in tons per year at expected and maximum utilization	PSD Permit Application and this MACT Analysis
(x) A recommended emission limitation for the constructed or reconstructed major source consistent with the principles set forth in §63.43(d)	This MACT Analysis
(xi) The selected control technology to meet the recommended MACT emission limitation	This MACT Analysis
(xii) Supporting documentation, including identification of alternative control technologies considered by the applicant to meet the emission limitation	This MACT Analysis
(xiii) Any other relevant information required pursuant to 40 CFR 63 Subpart A	This MACT Analysis

1.5 Overview of Texas GulfLink's Case-by-Case MACT Analysis Methodology

Defining MACT is generally a two-step process: 1) identify a control technology that represents the highest control achieved in practice by the best-controlled similar source (i.e. the MACT floor), and 2) determine whether stricter controls are achievable in light of costs, non-air quality health and environmental impacts, and energy requirements (i.e. beyond the floor). Texas GulfLink's case-by-case MACT analysis is based on this two-step process. Texas GulfLink's methodology entails first identifying the emission control achieved in practices by the best controlled similar source, then analyzing whether that is achievable at the proposed deepwater port facility, and then using that information to determine MACT (i.e. the maximum degree of reduction in emissions of HAPs that is achieved in practice.

Section 2.0 of this application describes the processes, emissions sources, and emissions calculations associated with the proposed facility. This information is presented to assist the reader in understanding the MACT concept of "similar source" and to assist in determining technically feasible control technologies. Section 3.0 presents an evaluation of control technologies used in practice for similar sources, and Section 4.0 discusses technical feasibility of application of the emission control technologies utilized by similar sources to the proposed Texas GulfLink deepwater port facility. Section 5.0 presents the proposed MACT control technology and operational standards of the control technology in order to demonstrate continued compliance.

2.0 Deepwater Loading Port Case-by-Case MACT Considerations

2.1 Deepwater Port Process Description

The proposed Texas GulfLink deepwater port facility will consist of a permanently manned offshore platform with two associated SPM buoys for the loading of VLCCs and other crude tankers. Sweet crude oil with a maximum Reid Vapor Pressure (RVP) of 10 psi will be pumped via pipeline from the onshore Jones Creek Crude Storage Terminal to the deepwater port facility for loading into the VLCCs and other crude oil tankers. Air emissions from the deepwater port operations will originate from the following emission sources (Emission Point Number ["EPN'] given):

- VOC emissions from marine loading of crude oil into VLCC vessels [EPN (S) M-1]
- Combustion emissions from 2 diesel electric generator engines [EPNs (P) G-1 and (P) G-2]
- Combustion emissions from 1 diesel portal crane engine [EPN (P) C-1]
- VOC emissions from 1 fixed roof tank storing diesel fuel [EPN (P) DT-1]
- VOC emissions from 4 "belly" tanks (i.e., diesel fuel tanks for electric generators, FWP, and crane engines) [(P) BT-1, BT-2, BT-3, and BT-4]
- VOC emissions from 1 fixed roof crude oil surge tank [EPN (P) T-1]
- Combustion emissions from 1 diesel emergency firewater pump engine [EPN (P) FWP-1]
- VOC emissions from pipeline pigging operations [EPN (P) P-1]
- Fugitive VOC emissions from platform piping components [EPN (P) F-1]
- Fugitive VOC emissions from piping components on 2 SPM loading buoys [EPN (S) F-2]
- VOC emissions from crude oil sampling activities [EPN (P) S-1]
- VOC emissions from pump maintenance [EPN (P) PM-1]
- VOC and PM emissions from maintenance-related abrasive blasting/painting [EPN (P) MSS-1]

A summary of each EPN, its description, and expected pollutants is presented in Table 2-1.

Table 2-1 Summary of Emission Sources at Deepwater Port Facility

EPN *	Description	Pollutant
(S) M-1	Marine loading into VLCCs	VOC **
(P) G-1	Diesel-fired electric generator engine	Combustion ***
(P) G-2	Diesel-fired electric generator engine	Combustion
(P) C-1	Diesel-fired portal crane engine	Combustion
(P) DT-1	Day tank storing diesel fuel (fixed roof)	VOC
(P) BT-1	Belly Tank 1	VOC
(P) BT-2	Belly Tank 2	VOC
(P) BT-3	Belly Tank 3	VOC
(P) BT-4	Belly Tank 4	VOC
(P) T-1	Crude oil surge tank (fixed roof)	VOC
(P) FWP-1	Diesel-fired emergency firewater pump engine (*MSS activity*)	Combustion
(P) P-1	Pipeline pigging operations (*MSS activity*)	VOC
(P) F-1	Fugitives from platform piping component leaks	VOC
(S) F-2	Fugitives from SPMs piping component leaks	VOC
(P) S-1	Crude oil sampling activities	VOC
(P) PM-1	Routine pump maintenance (*MSS activity*)	VOC
(P) MSS-1	Painting/Abrasive Blasting (*MSS activity*)	VOC, PM_{10}/$PM_{2.5}$

* (P) stands for Platform, (S) stands for SPM mooring

** VOC emissions include speciated hazardous air pollutants (HAPs), such as benzene

*** Combustion pollutants are NOx, CO, SO_2, PM, PM_{10}, $PM_{2.5}$, GHG (CO_2e), and un-combusted VOC

A simplified process flow diagram illustrating the offshore deepwater port's process is provided as Figure 2 in this analysis.

2.2 Deepwater Port Technical Considerations

Unlike onshore, inshore, and near shore port facilities, which are typically situated in protected or semi-protected waters, offshore deepwater port facilities present complicated operational challenges due to the VLCC's draft, dimensions and dead weight tons acting in extreme physical conditions posed by open water environments. Marine loading and unloading activities in offshore, unprotected marine environments are subject to variable currents, swells and high seas, and squall lines, which pose both navigational concerns as well as substantial technical challenges with vapor recovery that have not been solved by the offshore crude oil loading industry at facilities like Texas GulfLink. SPM buoy-type moorings must allow the tankers to weathervane around the buoy, which further limits vapor recovery options. Attachments, Figure 8 shows the Terminal Geographic Location Reference

2.2.1 Safe-Port-Design concept

Tankers moored at Texas GulfLink will be 1.25 nautical miles ("nm") or 7,595 feet from the manned platform. Other Deepwater Port ("DWP") applicants have proposed that tankers be moored much closer to the manned platforms. Drawing from its leadership team's significant navigational and marine safety experience, it is the opinion of Texas GulfLink that tankers should be moored no closer than 1.0 nm (or 6,080 feet) from manned platforms in open seas and preferably farther. If a ship comes within 1,200 feet of a manned platform, the platform should consider evacuation procedures. Tankers are approximately 1,100 feet in length. The mooring hawser for the tanker is 180 feet in length. The tug and tow line add 1,180 feet for a total of 2,460 feet. A platform situated only 0.65 nm (or 3,950 feet) from an SPM leaves only 1,490 feet between the manned platform and the tanker (with tethered tug), a distance that is dangerously close, leaving little room for safe maneuvering when the tanker is weathervane stern towards the platform. Tankers backing clear of the SPM (550 ft or ½ ship length) in this alignment could easily threaten the platform, possibly triggering an evacuation event. Unmooring in rough seas, when the line boats are unable to recover the hoses and mooring lines, becomes a critical operation due to the proximity of the platform at the 0.65 nm distance. Refer to Figure 3 for a diagram which illustrates the required maneuvering area safety buffers around platforms and SPMs.

The Texas Gulflink deepwater port will follow a "Safe-Port-Design" concept for unprotected waters. This design concept is developed by compiling guidance from Oil Companies International Marine Forum ("OCIMF") Singe Point Mooring Operational and Maintenance Guide ("SMOG") 3rd Edition 2015, ABS Rules for Building and Classing Single Point Moorings (Jan 2019), LOOP's 30+ year proven model with 10,000 tanker moorings and input from a 18-year Mooring Master of VLCCs at SPMs. The resulting Safe-Port-Design provides for 1.25 nm between the platform and SPMs. Texas GulfLink's customers, major shippers of crude oil, demand a high-level of risk mitigation. The additional distance between the SPM and the platform is a key element of this Safe-Port-Design concept. It is also based on distances actually used in practice at offshore crude oil loading facilities. The distance between the SPM and platform, in unprotected waters, must provide a safety margin to prevent the tanker from striking the manned platform in the event of tanker equipment failure or SPM mooring gear failure including days of extreme weather conditions.

This approach is echoed by criteria outlined in the Oil Companies International Marine Forum ("OCIMF") Singe Point Mooring Operational and Maintenance Guide ("SMOG") 3rd Edition 2015, which states:

"The design process should take account of the need for adequate maneuvering room around the SPM. There are no fixed rules that can be applied to determine the minimum maneuvering area or the minimum clearance from fixed facilities or obstructions. These should be determined by a risk/consequence assessment that takes into account the:

- Route tankers will take from the sea to approach the SPM.
- Tug assistance to be used.
- Mooring operation.
- Size of the **swinging area around the SPM**, taking into account **the hawser length**,
- Maximum tanker length and, where required, adequate **space for tugs and static towing arrangements**.
- Departure procedures.
- **Tanker breakout and emergency departure procedures**.
- **Operational environmental conditions**.
- Tanker draught and water depth at each stage of operations.
- Passage plan's final abort position.
- **Detailed input from the local harbor (sic) authority and pilots**.

The SPM site should be selected to remain a safe distance from obstructions and to avoid:

- **Interaction of tankers with adjacent facilities during normal approach and departure.**
- Channels and anchorages.
- Existing infrastructure, such as pipelines and cables.
- Navigational buoys.
- Fishing activities.
- Environmentally sensitive areas.”

Additionally, in a January 2019 American Bureau of Shipping (“ABS”) update to Rules for Building and Classing with regards to Single Point Moorings, the following is stipulated:

> “The maneuvering area is to be indicated and captioned on the site chart. The maneuvering area is defined as the area through which a vessel is to maneuver in making an approach to, or a departure from, the SPM. **The shape and size of the maneuvering area are to be established based on pertinent local conditions**. The radius of the maneuvering area about the mooring is to be at least three (3) times the length of the largest vessel for which the SPM is designed, plus the hawser length and maximum buoy offset in the Design Operating Condition defined in 3-1-2/7.1.1.”
>
> **‘Where mooring maneuvers are to be made in extreme environments, the minimum radius is to be increased.'**

Using the above equation, the <u>minimum radius</u> (not accounting for extreme environments) is:

(1100 ft VLCC + 180 ft Hawser + 30 ft offset) x 3 = 3930 ft ~ .65 nm)

All proposed deepwater port projects under review by MARAD for licensing have similar operating limits, these conditions are stated as mooring operations in 9-foot seas and 30-knot winds, and tanker departure from the moorings in 12 to 14-foot seas and 40 knot winds. These are extreme environmental conditions, and 0.65 nm is inadequate for a proposed deepwater port design by any standard. (*See **Figure 10** for LOOP’s 2009 AIS Tracks*)

The referenced mooring design criteria from these respected maritime industry organizations further reinforces the conservative design basis of the proposed Texas GulfLink deepwater port facility.

Drawing from the significant navigational and maritime experience of the Texas GulfLink team, Texas GulfLink believes a Safe-Port-Design should be based on a 1.25 nm distance from the SPM to platform. This is consistent with designs used in practice. Table 2-2 presents a comparison of the various DWP applicants' designs to the Texas GulfLink design and designs used in practice

Table 2-2 Marine Terminal Comparison of Existing Operations and Proposed DWPs

Deepwater Port	Offshore Distance (Nautical Miles)	Water Depth (ft)	Manned Platform	Unprotected Waters	Platform to SPM Distance (nm)	Proposed or operational VR	SPM Type	Pipe/Hose Tanker to Platform	VOC Management Plan	Operational	Safe Deepwater Port Design distance [2]
SPOT	30	115	√	√	0.65	√	CALM	4000 ft			
COLT	27.8	110	√	√	1.00	√	CALM	6080 ft			
TGL	**28.3**	**104**	√	√	**1.25**		**CALM**	**9000 ft**	√		√
TGTI	12.7	93		√	n/a		CALM	n/a	√		n/a
Bluewater	15	89		√	n/a		CALM	n/a	√		n/a
LOOP	**18**	**115**	√	√	**1.3**		**SALM**	**9200 ft**	√	√	√
Exxon W. Africa[1]	50+	500 +	√	√	1.14		CALM	8500 ft	√	√	√

1. *Exxon West Africa fixed Kizomba (3) FSPOs to CALM.*
2. *Distance from SPM to Platform > 1.1 nm in unprotected waters*

Additional Vapor Recovery Concerns

Capturing hydrocarbon vapors during offshore marine loading operations would require additional vapor hoses between the tanker and the SPMs, additional vapor hoses between the SPMs and the PLEMs, and additional pipelines between the PLEMs and the platform where the vapor combustor would necessarily be located. That is, in addition to the rigid subsea pipelines carrying crude oil from the platform to the PLEMs, and the flexible cargo hoses carrying crude oil from the PLEMs to the SPMs and from the SPMs to the tankers being loaded, another set of flexible hoses and rigid pipelines would be required to transport the vapors away from the tanker to the SPM, from the SPMs to the PLEMs, and then from the PLEMs to the platform. A floating cargo hose, filled with crude oil will have less buoyancy than a vapor hose, containing only vapors. The vapor hose would ride much higher on the water's surface. While attempting to move the hoses away from a tanker approaching the SPM or sailing away from the SPM, the vapor hose will tend to ride up and over the deeper floating cargo hoses, fouling easily. The additional vapor hoses and associated fittings may tangle with each other, especially during rough seas, causing operational issues while unmooring. The proximity to the platform while unmooring could endanger the tanker if the hoses entangle themselves, preventing them from being pulled away by the support boats. Furthermore, because the Texas GulfLink design calls for approximately double the distance between the tankers moored at the SPMs and the manned platform (Safe-Port-Design) as compared to some other deepwater port applicants, the length of any vapor recovery hoses would be approximately 9,139 ft. Thus, the technical concerns associated with vapor recovery lines discussed below make vapor recovery potentially even more difficult and dangerous to implement under Texas Gulflink's Safe-Port-Design layout. This weighs in favor of considering other factors besides just the presence of a platform in determining whether vapor recovery/vapor combustion should be required—factors that should be considered via a case-by-case analysis under Subpart B.

Further, under OCIMF guidelines, tankers should follow applicable Classification recommendations (ABS, in this instance) that stipulate that the tanker should operate at about 70% of the pressure-vacuum relief valve setting (or 1.4 psig). USCG regulations limit the rate of cargo transfer to the lesser of three values, one of which is determined by using 80% of the total venting capacity of the pressure relief valves in the cargo tank venting system when relieving at the set pressure, which is 1.6 psig based on a 2.0-psig set pressure. 46 CFR § 39.3001. (The mechanical pressure-vacuum relief valves are set at 2.0 psi).

Rapidly changing currents or seas (which are inevitable) will influence the vapor hose profile from the SPM to the tanker's manifold~~,~~ possibly resulting in temporary partial kinking of the vapor hose as the vapor hose string reacts to the movements. Any kinking of the vapor hose will create additional backpressure on the tanker, which is already operating near the pressure/vacuum ("p/v") operational limits. Partial kinking of the vapor hose may also occur when the vapor-filled hose bends at the tanker's manifold rail. Partial kinking of the vapor hose will instantly affect the vapor flow from the tanker and increase cargo tank pressure. In the final 10-15% stage of loading, where the vapor space in the cargo tanks is relatively small, pressure spikes will be amplified.

Photo 2-1: SPM loading hoses floating in ocean water (showing potential for formation of liquid slugs in the lines as the hose conforms to the wave crests and troughs of the seas).

Furthermore, in a warm ambient air environment where these vapor lines are floating on and partially submerged in the cooler seawater, it is inevitable that some of the vapors will condense and accumulate in the hose. The summer months in the northern Gulf of México will see daytime temperatures near 95° F causing radiation heating of the tanker's cargo tank tops and side shell plating, in the ballast condition, elevating the temperature of the cargo tank vapor. The condensation of the vapor will pocket at the bottom of the vapor hose, conforming to the seas, in the wave troughs. The pattern of the seas, crests-to-troughs, will cause numerous low points in the 1,100 ft floating hose string, where the liquids will pool. Over time, the motion of the seas will cause sloshing of the pooled liquids, resulting in liquid slugs. The inertia of the wave motion, as the vessel weathervanes into the seas, will result in a force driving the liquid slugs towards the stern of the tanker, away from the SPM. Liquid slugs will restrict or temporarily block vapor flow. In the final 10-15% stage of loading, where the vapor space in the cargo tanks is relatively small, pressure spikes will be amplified. The tanker and its crew will be subject to possible harm from the relief valves lifting (2.0 psi – mechanical bullet, individual tank), liquid pressure vacuum ("p/v") venting (2.5 psi – single liquid filled breaker, all tanks vent to atmospheric pressure), or structural damage (3.6 psi - tank tops first to fail), if the pressure spikes quickly above the operating 1.6 psi due to a blockage from a liquid slug in the vapor hoses.

In addition to back-pressure issues caused by condensation and kinking, there are other operational issues with recovering vapors from a tanker moored at an SPM. For example, the hose string from the tanker manifold drops about 30 feet from the tanker to sea level, then travels approximately 1,100 feet on the surface of the water with the hoses in motion from the rolling seas, then rises about 8 to 10 feet to the top of the SPM buoy. This effectively creates a large "p-trap." It would take approximately 4.0 psi to lift the liquid drop-out in the vapor hose over the SPM swivel to clear the liquid from the vapor hose. The tanker sustains structural damage above 3.6 psi. The liquid in the floating hose string is effectively trapped between the tanker's manifold connection and the top of the swivel connection on the SPM. There are no means to measure, drain or monitor the amount of liquid drop out during loading. Also, there are no means to drain the vapor hoses between consecutive loads, cumulatively increasing the pooling liquid within the vapor hose.

Refer to Figure 4 for a detailed diagram that illustrates technical issues associated with vapor recovery from floating hoses.

Employing vapor combustion on the platform will require the use of a detonation arrester to prevent fires or explosions in the vapor recovery lines and hoses leading back to the tanker.

USCG regulations require that the distance between the detonation arrester and the facility vapor connection not exceed 18 meters (59.1 feet). However, the facility vapor connection and detonation arrester would have to be located on the platform—far from the tanker and SPM. As a result, the following components would be left unprotected: the vapor recovery pipelines leading from the platform to the PLEM, the PLEM to the subsea vapor hoses leading to the SPM, the SPM, and the floating vapor hoses leading back to the tanker from the SPM. A linear distance of 9,139 feet from the platform to the tanker causes a pressure drop that requires a substantial vacuum to draw the vapors to the platform vapor destructors. This pressure drop results from a combination of floating hoses, SPM swivel, subsea riser hoses, and rigid pipelines. The SPM swivel and flanges may be in a vacuum state. As a result, the SPM swivel is a possible source of fresh air and static charge that could ignite the vapors and cause an explosion at the SPM, or worse, at the tanker. A leak at a flange connection or swivel at the SPM could draw in fresh air if a vacuum state exists. A perfect fire "triangle" could be possible: hydrocarbon vapors, fresh oxygen, and a static charge accumulated from the moist air. An explosion the SPM would instantly rupture the cargo hoses carrying the crude oil to the tanker and the vapor hose, resulting in a crude oil spill that could ignite in close, perilous proximity to the tanker. Additionally, the flow of hydrocarbon vapors from a ruptured vapor hose would provide a continuous flow until the tanker could secure its manual operated manifold block valve.

These considerations are discussed further in Section 4.2 – Feasibility of Available Control Technology.

2.3 Deepwater Port Emission Calculations

In this section, a summary of the maximum pollutant emission rates estimated for the proposed deepwater port facility operations are described. Operation of the offshore facility will result primarily in emissions of volatile organic compounds ("VOC"). Lesser amounts will be emitted of nitrogen oxides ("NO_X"), sulfur dioxide ("SO_2"), carbon monoxide ("CO"), hydrogen sulfide ("H_2S"), particulate matter ("PM"), including PM with an aerodynamic diameter of 10 microns or less ("PM_{10}") and 2.5 microns or less ("$PM_{2.5}$"), and hazardous air pollutants ("HAPs") including benzene. Greenhouse gas ("GHG") emissions, expressed as carbon dioxide equivalent ("CO_2e"), were also addressed. Maximum hourly (lb/hr) and annual average (tons/yr) emission rates were estimated for each source of emissions. The emissions are on a Potential-to-Emit ("PTE") basis. Detailed emission rate calculations are provided in the Prevention of Significant Deterioration

("PSD") permit application included in the Texas GulfLink deepwater port license application and in the "Emission Rates" section below.

The following sections describe the crude oil composition data, including HAP speciation in the crude, used in estimating VOC emissions from marine loading. Additionally, an analysis is given that shows the expected "weathering" of raw crude oil with respect to the emission of highly volatile compounds (e.g. methane, ethane, carbon dioxide, etc.) as the crude travels from the upstream wellsite to the Jones Creek Crude Storage Terminal. Finally, summaries of the estimated emissions included in the PSD air permit application and the "indirect" emission sources (e.g. marine vessels such as tug, line, and positioning boats) are given, along with a comparison of emissions that shows the expected reduction in emissions that will be realized by implementing the proposed Texas GulfLink Project versus continuing to use lightering vessels to transport crude oil offshore to load into VLCCs.

Crude Composition

The crude oil physical property and composition data used in the marine loading emission rate calculation include the following:

Reid Vapor Pressure (RVP) = 10 psia

Maximum True Vapor Pressure (TVP_{max}) (80 ^oF) = 9.84 psia

Annual Average True Vapor Pressure (TVP_{avg}) (80 ^oF) = 8.98 psia

Vapor Molecular Weight (MWv) = 50 lb/lb-mole

Liquid Molecular Weight (LMW) = 207 lb/lb-mole

Liquid Density (60 ^oF) = 7.1 lb/gal

Maximum H_2S Crude Concentration = 24 ppm_v

Average H_2S Crude Concentration = 5 ppm_v

The following table gives the typical HAP speciation profile for crude oil used in the marine loading emission calculation.

Table 2-3 HAP Speciation

Species	Vapor Weight %	Vapor Weight Fraction
Benzene	0.44	0.0044
Ethylbenzene	0.03	0.0003
n-Hexane	2.28	0.0228
Isooctane	0.04	0.0004
Cyclohexane	0.53	0.0053
Toluene	0.22	0.0022
Xylene	0.09	0.0009

Crude Weathering

Emissions of highly volatile compounds, such as methane, were not considered in the marine loading emissions. As described below, by the time crude oil will reach the Texas GulfLink onshore Jones Creek Crude Storage Terminal, most of the very volatile compounds within the crude are assumed to be emitted ("weathered") out.

Raw crude oil produced from the well will first be stored in local lease tanks at the well site location. These tanks are typically fixed roof tanks with vents to either the atmosphere or to a low pressure flare system. From the well site, the crude will be transported via tanker truck or pipeline to a field gathering system and typically stored in external floating roof ("EFR") storage tanks. From the field gathering system, the crude will be pumped to storage facilities in the Houston area. Crude destined for Texas GulfLink will be batched and pumped from the Houston area storage facilities to the Jones Creek Crude Storage Terminal. At the Jones Creek Crude Storage Terminal, the crude will be stored in domed EFR ("DEFR") tanks first, then metered and pumped offshore to be loaded into VLCC vessels and other crude tankers.

As the crude oil is transferred from the well site to the Jones Creek Crude Storage Terminal, light-end (volatile) compounds such as methane, ethane, propane, carbon dioxide, and nitrogen, will be emitted along the way. The highest level of emissions will occur as the crude is produced from the well, under pressure, and pumped into the atmospheric tanks at the well site. Flashing of gas entrained in the crude occurs at this step due to pressure drop. From typical emission calculations (using TCEQ's Oil and Gas Emissions Spreadsheet) for sweet crude produced in the Permian Basin, approximately 96% of total emissions is from flash gas at this step. A typical flash gas composition follows:

Figure 5 Example Crude Oil Flash Gas Composition

GOR Calculator

This table can be used to calculate the flash gas molecular weight and the component weight percents if needed, if the flash gas mole percents are entered. It can also calculate the overall VOC, benzene, and H2S flash emissions if the GOR and the oil/condensate throughput are entered.

Gas Oil Ratio:	19.1	in standard cubic feet of flash gas per barrel (SCF/bbl) of oil/condensate produced
Barrels of Oil or Condensate per day:	4500	

Flash Gas Speciation:						
Component	**mole %**	Molecular Weight (grams/mole, lb/lb-mol)	grams per 100 moles of gas	**weight %**	Flash Gas MW =	34.729702
hydrogen		2.01588	0	0.0000	Total gas emitted:	
helium		4.0026	0	0.0000	lb/hr:	327.750333
nitrogen	0.7970	28.01340	22	0.6429	tpy:	1435.54646
CO2	0.7520	44.00950	33	0.9529		
H2S	0.0010	34.08188	0	0.0010	VOC wt% =	64.6025
methane (C1)	37.8800	16.04246	608	17.4977		
ethane (C2)	18.8300	30.06904	566	16.3030	VOC, lb/hr:	211.734938
propane (C3)	23.5040	44.09562	1036	29.8426	VOC, tpy:	927.39903
butanes (C4)	11.2060	58.12220	651	18.7539		
pentanes (C5)	4.4450	72.14878	321	9.2342	Benzene wt% =	0.1304
benzene	0.0580	78.110000	5	0.1304		
other hexanes (C6)	1.7250	86.18000	149	4.2805	Benzene, lb/hr:	0.42753996
toluene	0.0220	92.140000	2	0.0584	Benzene, tpy:	1.87262504
other heptanes (C7)	0.6640	100.20000	67	1.9157		
ethylbenzene	0.0010	106.170000	0	0.0031	H_2S wt% =	0.0010
xylenes (o, m, p)	0.0010	106.170000	0	0.0031		
other octanes (C8)	0.1090	114.23000	12	0.3585	H_2S, lb/hr:	0.00321637
nonanes (C9)	0.0060	128.26000	1	0.0222	H_2S, tpy:	0.01408769
decanes plus (C10+)			0	0.0000		
Totals:	100.0010	34.73	3473	100.00		

As shown in the above table, approximately 80%$_{vol}$ of the flash gas, which is almost all (96%) of the total emissions, is made up of methane, ethane, and propane. Other volatile compounds, such as nitrogen and carbon dioxide, make up a very small (less than 1%$_{vol}$) amount of the flash gas. These volatile compounds will continue to be emitted from the crude as it is transferred along the supply route from the well site to the Jones Creek Crude Storage Terminal (i.e., 4 additional storage and transfer steps each producing volatile emissions). By the time the crude reaches the Jones Creek Crude Storage Terminal, nearly all of the highly volatile compounds (e.g. methane, ethane, propane, carbon dioxide, and nitrogen) will have been emitted, leaving only the less volatile VOCs to be emitted.

Emission Rates

Table 2-4 below summarizes the site-wide total annual PTE emission rates of the criteria and greenhouse gas (CO_2e) pollutants for the proposed deepwater port facility.

Table 2-4 Summary of Criteria and GHG PTE Rates for Deepwater Port Facility

EPN	Source	CO_2e		PM_{10}		$PM_{2.5}$		SO_2		NOx		CO		Total VOC	
		(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
(S) M-1	Marine Loading													4,709.72	9,679.15
(P) G-1	Generator 1	4,856	4,406	0.32	1.39	0.32	1.39	0.01	0.05	9.92	43.45	5.57	24.40	0.27	1.16
(P) G-2	Generator 2	4,856	4,406	0.32	1.39	0.32	1.39	0.01	0.05	9.92	43.45	5.57	24.40	0.27	1.16
(P) C-1	Crane 1	485	2,132	0.14	0.61	0.14	0.61	0.01	0.02	2.59	11.32	2.45	10.71	0.21	0.92
(P) DT-1	Day Tank 1													0.001	0.01
(P) BT-1	Belly Tank 1													0.0002	0.001
(P) BT-2	Belly Tank 2													0.0002	0.001
(P) BT-3	Belly Tank 3													0.0002	0.001
(P) BT-4	Belly Tank 4													0.00002	0.0001
(P) T-1	Surge Tank													0.40	1.74
(P) FWP-1	MSS - Firewater Pump	5	20	0.12	0.01	0.12	0.01			2.12	0.11	2.01	0.10	0.18	0.01
(P) P-1	MSS - Pigging Operations													83.76	0.50
(P) F-1	Platform Fugitive Emissions													0.03	0.12
(S) F-2	SPM System Fugitives													0.10	0.44
(P) S-1	Sampling Activities													0.10	0.05
(P) PM-1	MSS - Pump Maintenance													4.00	0.002
(P) MSS-1	MSS - Abrasive Blasting / Painting			0.01	0.06	0.002	0.01							0.06	0.26
	TOTAL EMISSIONS (TPY)	**10,201**	**10,965**	**0.91**	**3.47**	**0.89**	**3.42**	**0.03**	**0.13**	**24.54**	**98.33**	**15.60**	**59.60**	**4,799.10**	**9,685.53**

(Attachments - Figure 9 shows a landscape version of this table)

The table shows both maximum hourly (pounds per hour, lb/hr) and annual average (tons per year, tpy) emission rates.

As shown in Table 2-4, the total site-wide VOC emission rate is greater than the PSD major source emissions threshold of 250 tpy. As described in more detail in Section 4.0 of the PSD permit application (submitted under separate cover), because emissions of VOC trigger PSD for the offshore facility, the other pollutants' emission increases are compared to their respective PSD *significance* emission thresholds. The PSD significance threshold for NO_X is 40 tpy; therefore, as shown in the table, PSD is triggered for NO_X as well. The other pollutants have increases below their respective PSD significance emission thresholds; thus, the facility would be considered minor with respect to PSD for these pollutants.

Table 2-5 summarizes the site-wide total annual PTE emission rates of H_2S and HAPs for the proposed deepwater port Facility.

Table 2-5 Summary of H_2S and HAP PTE Rates for Deepwater Port Facility

EPN	Source	H_2S		Acetaldehyde		Benzene		Isopropylbenzene		Ethylbenzene		Formaldehyde		Hexane (-n)		2,2,4-Trimethylpentane (isooctane)		Toluene		Xylene (-m)	
		(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
(S) M-1	Marine Loading	0.12	0.05			20.78	42.70	0.16	0.33	1.39	2.86			107.53	220.99	1.79	3.67	10.17	20.90	4.08	8.38
(P) G-1	Generator 1			0.0002	0.001	0.01	0.02					0.001	0.002					0.002	0.01	0.002	0.01
(P) G-2	Generator 2			0.0002	0.001	0.01	0.02					0.001	0.002					0.002	0.01	0.002	0.01
(P) C-1	Crane 1											0.004	0.02								
(P) DT-1	Day Tank 1																				
(P) BT-1	Belly Tank 1																				
(P) BT-2	Belly Tank 2																				
(P) BT-3	Belly Tank 3																				
(P) BT-4	Belly Tank 4																				
(P) T-1	Surge Tank					0.002	0.01			0.0001	0.001			0.01	0.04			0.001	0.004	0.0003	0.002
(P) FWP-1	MSS - Firewater Pump																				
(P) P-1	MSS - Pigging Operations					0.37	0.002							1.91	0.01			0.18	0.001		
(P) F-1	Platform Fugitive Emissions						0.0007062							0.0005	0.002				0.001177	0.0004	0.002
(S) F-2	SPM System Fugitives																				
(P) S-1	Sampling Activities																				
(P) PM-1	MSS - Pump Maintenance																				
(P) MSS-1	MSS - Abrasive Blasting / Painting																				
	TOTAL EMISSIONS (TPY)	0.12	0.05	0.0003	0.001	21.16	42.75	0.16	0.33	1.39	2.86	0.005	0.02	109.45	221.04	1.79	3.67	10.36	20.92	4.08	8.39

As shown in the table, the maximum hourly and annual average emission rates for H_2S for marine loading are 0.12 lb/hr and 0.05 tpy, respectively. The H_2S emission rates were obtained assuming a maximum H_2S crude concentration of 24 ppm_v (for the maximum hourly rate) and an average H_2S crude concentration of 5 ppm_v (for the annual average rate). Based upon crude assay data for sweet crudes, these H_2S concentrations are conservatively high.

The major source definition that would make a facility major for HAPs is 10 tpy of a single HAP or 25 tpy of an aggregate of all HAPs. As shown in Table 2-5, there are individual HAPs that will have emission rates greater than 10 tpy (i.e., benzene, n-hexane, and toluene). Additionally, the aggregate total emissions from all HAPs is greater than 25 tpy. Therefore, the deepwater port facility is considered major with respect to HAPs.

Lightering Analysis

Lightering emissions were estimated to understand how the proposed Texas GulfLink Project would benefit the environment upon its implementation. Lightering emissions are those that result from the operation of lightering vessels that are loaded at the shore dock with crude oil, travel out to the moored VLCC, and the crude is offloaded into a VLCC.

For developing lightering emission calculations, it was estimated (based on Texas GulfLink's significant maritime experience) that 97% of lightering is *complete* lightering, meaning the lightering vessel is completely loaded at the shore dock before it travels out to the VLCC. Therefore, 3% of lightering was estimated to be *partial* lightering, meaning the lightering vessel is partially loaded at the dock, down to a specified hull draft depth, before it travels out to the VLCC.

Typically, the larger lightering vessels are partially loaded because at full load, their hulls would be dragging along the sea bottom.

It was estimated that lightering is performed with 85% Aframax tankers and 15% Suezmax tankers. The four lightering scenarios considered are presented in Table 2-6 below, and a total representative sum for annual lightering was based on these scenario percentages.

Table 2-6 Lightering Scenarios Considered for Emission Calculations

Scenario 1:	Complete/Aframax	97%	85%	82.5%
Scenario 2:	Complete/Suezmax	97%	15%	14.6%
Scenario 3:	Partial/Aframax	3%	85%	2.6%
Scenario 4:	Partial/Suezmax	3%	15%	0.5%
				100.0%

Table 2-7 below summarizes the emissions of “criteria” and GHG (CO_2e) pollutants from lightering operations for each of the scenarios listed above. The marine loading emissions are included because the lightering vessels offload their crude oil into the VLCCs.

Table 2-8 below shows the estimated emission reductions that would be realized by implementing the proposed Texas GulfLink DWP Project, which would eliminate the need to transport crude oil out to VLCCs using lightering vessels. As shown in the table, approximately 4,200 tpy of NOx emissions would be reduced, and approximately 7,300 tpy of VOC emissions would be reduced by implementing the proposed Texas GulfLink Project.

Table 2-7 Offshore Lightering Emissions (Lightering Vessels and VLCC Loading)

Emission Source	NSR Regulated Air Pollutants & Greenhouse Gas Emissions (CO_2e)																						Hazardous Air Pollutants (HAPs)	
	PM		PM_{10}		$PM_{2.5}$		NO_2		SO_2		H_2SO_4		CO		VOC		H_2S		Pb		CO_2e		Total VOC HAPs	
	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy
(P) M-1, Marine Loading															4,709.72	9,679.15	0.12	0.05					145.89	299.83
Lightering Scenario 1 - COMPLETE/AFRAMAX	51.21	213.62	50.21	210.24	47.26	194.87	1,189.27	5,535.39	67.04	163.28	0.95	4.27	206.83	754.25	1,027.20	7,396.10	0.02	0.04	0.33	0.27	71,420	291,280	31.03	224.68
Lightering Scenario 2 - COMPLETE/SUEZMAX	51.21	137.70	50.21	135.17	47.26	125.56	1,189.27	3,527.23	67.04	114.51	0.95	2.74	206.83	507.39	1,914.70	7,315.62	0.05	0.04	0.33	0.26	49,894	212,709	58.53	223.84
Lightering Scenario 3 - PARTIAL/AFRAMAX	61.49	135.59	59.86	133.05	56.28	123.32	1,460.74	3,524.13	75.90	102.89	1.22	2.77	262.60	488.49	4,588.95	7,220.21	0.11	0.04	0.33	0.15	45,305	180,647	58.68	220.83
Lightering Scenario 4 - PARTIAL/SUEZMAX	59.35	96.48	57.73	94.49	53.97	87.66	1,485.04	2,491.20	58.96	75.76	1.26	1.98	261.20	355.81	5,478.39	7,178.94	0.14	0.04	0.17	0.13	33,563	137,789	113.63	220.38
TOTAL Lightering Operation Scenario	**51.51**	**200.06**	**50.49**	**196.83**	**47.52**	**182.48**	**1,197.53**	**5,178.22**	**67.22**	**154.25**	**0.96**	**4.00**	**208.49**	**709.76**	**5,976.91**	**17,058.08**	**0.15**	**0.09**	**0.33**	**0.27**	**67,451**	**276,336**	**182.00**	**524.27**

Table 2-8 Emissions Reductions by Eliminating Lightering Due to DWP Project

Scenario	PM		PM_{10}		$PM_{2.5}$		NO_x		SO_2		H_2SO_4		CO		VOC		H_2S		Pb		CO_2e		Total VOC HAPs	
	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy	lbs/hr	tpy
Proposed Project	27.93	34.72	26.89	31.32	25.49	30.05	665.28	961.74	37.55	37.74	0.61	1.12	151.77	338.52	4,824.14	9,721.89	0.12	0.05	0.165	0.025	14,782	64,783	148.91	300.62
Alternate Scenario - Lightering	51.51	200.06	50.49	196.83	47.52	182.48	1,197.53	5,178.22	67.22	154.25	0.96	4.00	208.49	709.76	5,976.91	17,058.08	0.15	0.09	0.328	0.267	67,451	276,336	182.00	524.27
Emissions Reduction from Proposed Project	**23.58**	**165.34**	**23.60**	**165.51**	**22.03**	**152.43**	**532.24**	**4,216.48**	**29.68**	**116.51**	**0.35**	**2.87**	**56.72**	**371.24**	**1,152.77**	**7,336.18**	**0.03**	**0.04**	**0.162**	**0.24**	**52,670**	**211,553**	**33.10**	**223.65**

3.0 Evaluation of Similar Sources

In accordance with the principles of MACT determinations specified in 40 CFR §63.43(d), the MACT requirements shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source. Similar source, as defined in §63.43, means a stationary source or process that has comparable emissions and is structurally similar in design and capacity to a constructed or reconstructed major source such that the source could be controlled using the same control technology.

The preamble to the 112(g) case-by-case MACT rule provides two criteria that should be used when determining if a source is considered similar: 1) whether the two sources have similar emissions, and 2) whether the source can be controlled with the same type of control technology. The preamble goes on to classify emission sources as one of five different types: 1) process vent or stack discharges; 2) equipment leaks; 3) evaporation and breathing losses; 4) transfer losses; and 5) operational losses. These five types of emission sources can serve as a general guide in identifying available control options while also considering the concentration and the type of constituents of an emissions stream. EPA also states that while two pieces of apparatus can be classified within the same emission source type, this does not automatically mean that the emission points can be controlled using the same type of control technology. In fact, the preamble explicitly states that "the EPA recognizes that control efficiencies across similar sources may be different. The permitting authority is expected to use its judgment in determining when operating conditions are comparable across emission units." (61 FR 68384)

The following subsections summarize the evaluation of available information on emission controls that are achieved in practice by similar sources. Per EPA guidance, this evaluation considered the following factors: the volume and concentration of emissions; the type of emissions; the similarity of emission points; and the effectiveness of controls relative to the effectiveness of those controls at the proposed deepwater port facility, as well as other operating conditions.

3.1 Similar Sources in the Marine Loading Industry

Of the similar source evaluation factors identified by EPA and listed above, Texas GulfLink considers the similarity of emission points and the effectiveness of controls as the most relevant factors.

In order to conduct a comprehensive evaluation of potential similar sources, Texas GulfLink looked beyond crude oil loading operations with SPMs and considered crude oil loading operations with different designs. The types of sources included in the evaluation are summarized in Table 3-1. In analyzing the similar sources, we categorized each source by its location relative to shore. “Onshore” facilities are those where the tankers moor at a fixed dock, platform, causeway, jetty, or pier. “In Shore” facilities are those located in an inland waterway such as a lake, river, harbor or bay. “Near Shore” facilities are those located less than 3 nautical miles (nm) from shore and “Offshore” facilities are those located more than 3 nm from shore. Similarly, facilities located in “Protected Waters” are in sheltered waters such as bays, rivers, harbors, inside breakwaters, or the lee side of a land mass whereas “Unprotected Waters” refer to the harsher environments experienced in unsheltered waters. Table 3-1 also identifies how vapors are handled (if at all), the emissions control used, the tanker class and whether dedicated tankers specially outfitted with vapor recovery are employed, how long the facility has been in service, and whether the emissions control technology or practice constitutes the MACT floor. Additional details about each of the facilities follow the table.

Table 3-1 Analyzing Potentially Similar Existing Sources – US Marine Terminals and Lightering

Facility	Potential Similar Source Loading Terminal	Location	Protected Water	Vapor Connection to the Tanker	Vapor Recovery at Facility	Subsea Vapor Pipeline	Floating Vapor Hose	Emission Reduction Method	Remark	Specially Designed Tanker/Barges	Maximum Tanker Class	Years in Service	MACT Floor
A	Causeway Jetty Mooring	In Shore	√	Fixed loading arm	√			VRU Facility	Established technology		VLCC	10+	
B	Causeway Jetty Mooring	In Shore	√	1 hose	√			VRU Facility	Unit on jetty				
C	Platform	In Shore	√	n/a				Dedicated VR tankers and limited VOC Management	Moored alongside	√	Handy	10+	
D	Platform	Near Shore	√	n/a				Exempt VR	Moored alongside		VLCCs	10+	
E	Multi-Buoy Mooring	Near Shore	√	n/a				Absorption	Dedicated Barge	√	Barge	10+	
F1	Multi-Buoy Mooring	Near Shore	√	~ 70 ft hose				Absorption	Stand-alone Barge VR Processing	√	AfraMax	8	
F2	Multi-Buoy Mooring	Near Shore	√	n/a				Absorption	Dedicated Tankers	√	Handy		
G	Multi-Buoy Mooring	Near Shore	√	n/a	√	√	√	VRU & Vapor Balance	Dedicated Tankers	√	Handy	½	
H	Offshore Storage & Treatment (OST)	Offshore		~300 ft hose	√		√	VRU OS&T	Dedicated Tanker	√	Handy	10+	
I	GOLA Reverse Lightering	Offshore		n/a				VOC Management Plan[17]	No Vapor Balancing		ULCC	10+	
J	Delaware River Lightering	In Shore	√	~ 70 ft hose	√			Vapor Balancing	Established technology		SuezMax	10+	
K	Single Point Mooring ***LOOP***	Offshore						VOC Management Plan	Only US Crude Oil DWP		ULCC	2	√
L	VR equipped Tanker	n/a		n/a				Active & Passive VR	Dedicated Shuttle Tanker	√	AfraMax	8	

A. Richmond Long Wharf, Richmond, CA.

The Richmond Long Wharf is the largest marine oil terminal in California. Tankers moor at an in-shore fixed berth in protected waters with vapor piped to an onshore facility using a chiksan (a fixed loading arm). Vapor recovery limits the facility to a 25,000 barrel per hour (“bph”) loading rate. Rigid pipelines transport product and vapors from berth to shore on an above-water pipe trestle. There are no subsea pipelines transporting product or vapors.

In contrast, Texas GulfLink will be located 28 miles offshore in deep, unprotected waters and the VLCCs will be moored to CALM SPMs—not a platform located in protected waters. Crude oil is pumped from shore and will be transported from shore to the SPM by way of the platform and PLEMs using subsea pipelines. Crude oil will be loaded from the SPMs onto the VLCCs using flexible hoses—not fixed loading arms—at an average of 60,000 bph (85,000 bph max). The platform does not control the flow or loading of the oil; rather, in terms of oil flow, the platform provides only metering, sampling, and surge protection. The cargo and booster pumps are located onshore, approximately 40 miles away, along with the control room and oil movement controllers. If vapor recovery is required at Texas GulfLink, vapors would have to be transported from the tankers to the SPMs via floating flexible hoses (subject to excessive vacuum, no flame propagation protection, kinking and formation of liquid dropout creating dangerous back-pressure) and from the SPM to the PLEM via subsea flexible hoses.

Photo 3-1: Richmond Long Wharf, Richmond, CA (in-shore berth located in protected waters).

Photo 3-2: Richmond Long Wharf, Richmond, CA (showing above-water pipeline trestle).

B. Phillips 66 Rodeo, CA Marine Terminal.[2]

The Phillips 66 Rodeo Marine Terminal has been located at the Rodeo facility since 1928. The existing marine terminal has been operating since 1955 with minor modifications. Tankers moor at an in-shore berth in relatively shallow protected waters. The facility utilizes a thermal oxidizer vapor control system designed to collect, transport, and combust vapors from ship-loading operations. Vapor recovery limits the maximum loading rate to 20,000 bph to prevent overloading the oxidizer. Cargo and recovered vapors are transported to shore via rigid pipelines along an above-water trestle. There are no subsea pipelines servicing the terminal. The vapor collection system uses a detonation arrester located at the berth vapor pipeline to prevent flame fronts from passing from the marine terminal to the ship. The vapor processing unit is located on a jetty approximately 630 feet from the moored tankers, a relatively short distance allowing successful vapor recovery.

[2] Marine Terminal Offload Limit Revision Project Phillips 66 Refinery, Rodeo, California. BAAQMD Permit Application 22904.

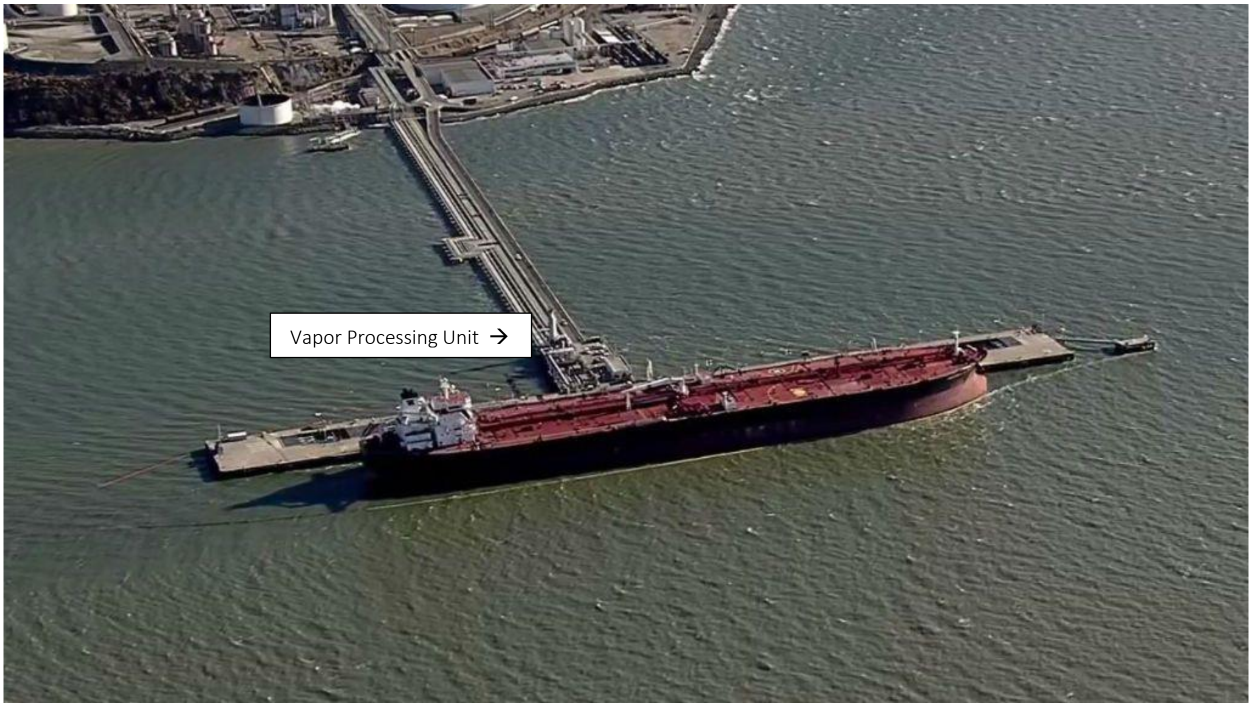


Photo 3-3: Phillips 66 Rodeo, CA Marine Terminal (in-shore berth located in protected waters).

Photo 3-4: Phillips 66 Rodeo, CA Marine Terminal (vapor processing unit located on jetty).

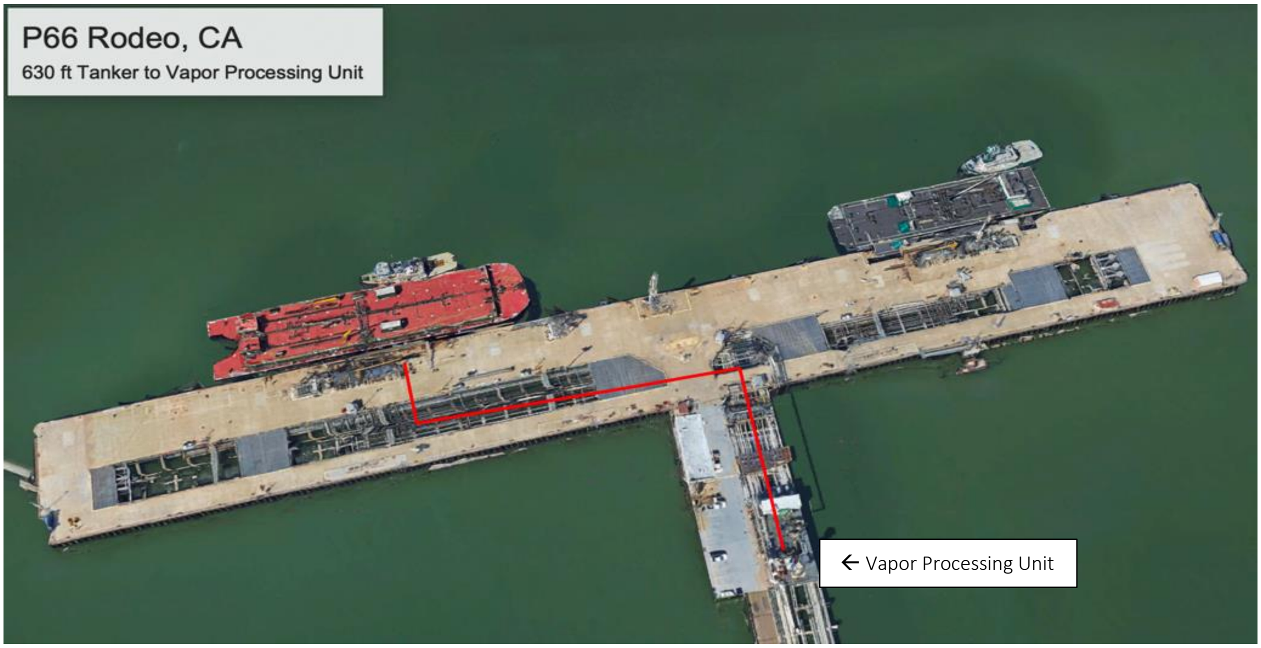


Photo 3-5: Phillips 66 Rodeo, CA Marine Terminal (showing distance from tanker to vapor processing unit located on jetty).

In contrast, Texas GulfLink will be located 28 miles offshore in deep, unprotected waters and the VLCCs will be moored to CALM SPMs—not an in-shore berth in protected waters. Crude oil is pumped from shore and will be transported from shore to the SPM by way of the platform to the PLEMs using subsea lines—not an above-water trestle. Texas GulfLink's loading rate will 3 to 4 times the rate of the Rodeo facility at an average of 60,000 bph (85,000 bph max). If vapor recovery is required at Texas GulfLink, vapors would have to be transported from the tankers to the SPMs via floating flexible hoses (subject to excessive vacuum, kinking and formation of liquid dropout creating dangerous back-pressure) and from the SPM to the PLEM via subsea flexible hoses. Detonation arresters would, out of physical necessity, be located on the platform—more than 1.25 nm from the tanker being loaded. However, USCG regulations require the arrester to be located no more than 18 meters from the vapor connection on the tanker.[3]

C. Drift River, AK, Marine Platform Oil Terminal.

The Drift River Christy Lee Platform is an in-shore crude oil loading facility located 2 miles from the nearest bank in 80 feet of water. Tankers berth at the fixed platform and oil is transported

[3] 33 CFR §154.2105(b)(1).

from tanker to platform using fixed loading arms. Oil is then delivered to the onshore terminal via 30-inch subsea pipelines. Vapor recovery occurs onboard using dedicated Handy tankers with vapor recovery equipment (the Mississippi & Florida Voyager) and limited non-vapor recovery operations by VOC Management Plan and submerged fill. The facility itself does not employ vapor recovery. Operated from 1968 to 2019, it is currently being decommissioned.

Photo 3-6: Drift River, AK, Christi Lee platform (showing fixed loading arm).

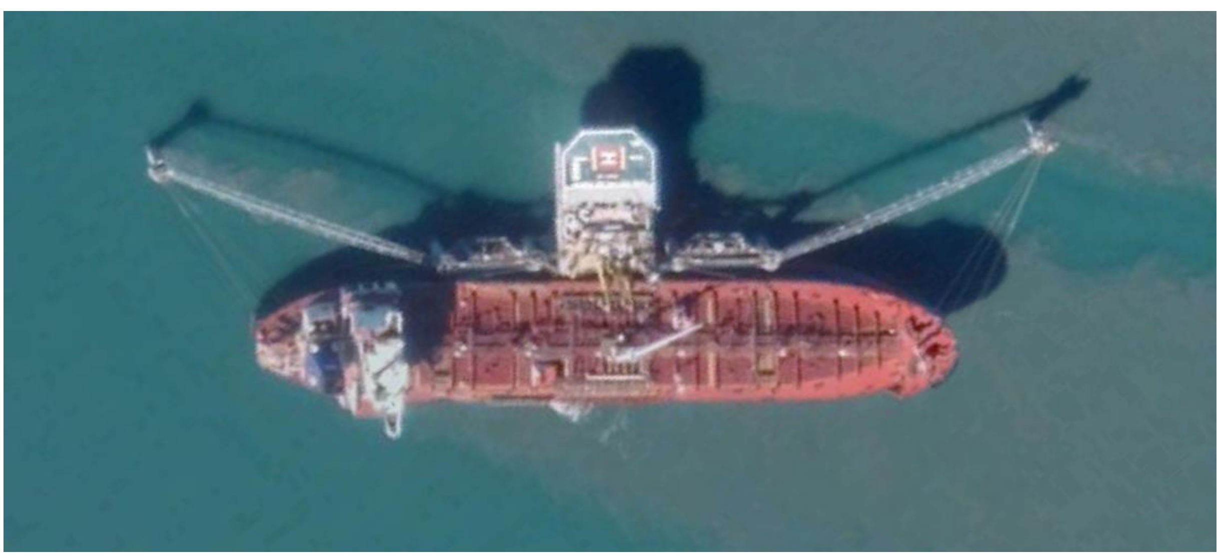


Photo 3-7: Drift River, AK, Christi Lee platform (tanker moored at platform).

Photo 3-8: Drift River, AK, Christi Lee platform.

Photo 3-8 above is an excellent example of a platform operating as a loading terminal. The platform has fixed loading arms, mooring dolphins and fendering to secure tankers at the platform. Located in protected waters, tankers may moor alongside the platform in a fixed stationary berth. Cargo oil flow is controlled at the platform. This platform has subsea cargo pipelines but did not provide vapor recovery at the facility.

In contrast, Texas GulfLink's manned platform is offshore, in unprotected waters, has no loading arms, no control over the flow of the oil, no mooring dolphins or fendering to secure tankers at the berth, and no cargo pumps. Tankers moor at the SPMs 1.25 nm away, weathervane about the SPM, and use floating hose connections to transfer the cargo from the SPM to the tanker.

SPMs do not have fixed loading arms, unlike Drift River, which used dedicated tankers outfitted with vapor recovery. Tankers loading at Texas GulfLink are owned by third parties and will likely not have on-board vapor recovery capabilities.

D. United Riverhead Marine Terminal, Suffolk, NY.

United Riverhead Terminal is a near-shore loading platform. Tankers are moored at a platform located approximately one mile off Long Island in 62 feet of water and are loaded using a fixed loading arm. It has 5.2 million barrels storage in 20 on-shore tanks, two 24-inch subsea pipelines that transport oil to the platform, and a multi-berth configuration that allows vessel to vessel transfers. This facility is designed for loading VLCCs. It does not employ vapor recovery. It was exempted from installing a vapor recovery system by the New York Department of Environmental Conservation. An analysis conducted by the facility demonstrated that the cost of installing an appropriate control device on the platform exceeded the cost effectiveness threshold established by the Department's DAR-20 guidance document. Accordingly, the Department granted United Riverhead Terminal a variance from the VOC RACT requirements of 6 NYCRR Part 229 for the operations conducted on the offshore loading platform.[4] Therefore, the tankers are loaded using submerged fill under a VOC Management Plan.

Photo 3-9: United River Head, NY, Platform Oil Terminal (VLCC berths located at the platform; tankers loaded using fixed loading arms).

[4] Emission unit U00005 - This emission unit includes the marine loading and unloading of petroleum and non-petroleum fuel liquids at an offshore platform. A variety of petroleum liquids including, but not limited to, crude oils, distillate oils, and residual oils are loaded and unloaded into marine vessels at the platform. The Department has granted a VOC RACT variance for the marine platform.

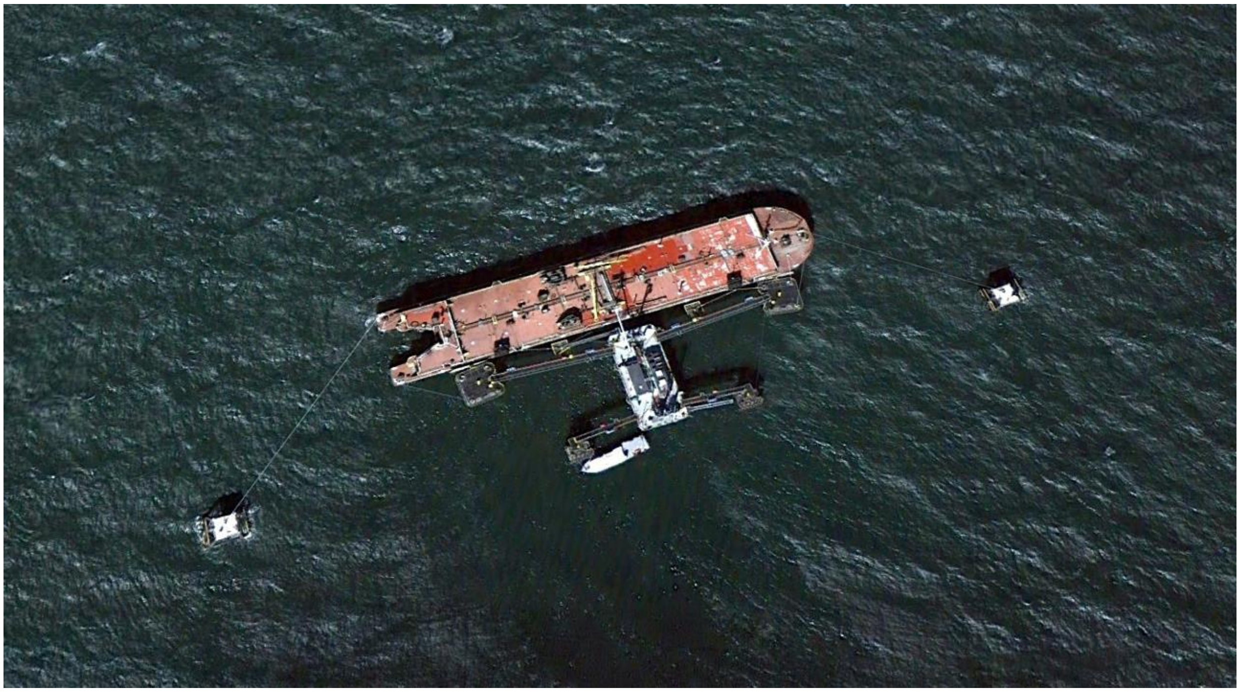


Photo 3-10: United River Head, NY, Platform Oil Terminal (VLCC moored at platform).

Texas GulfLink will be located offshore in deep, unprotected waters and the VLCCs will be moored to CALM SPMs—not a near-shore platform located in protected waters. SPMs do not have fixed loading arms. Like United Riverhead, Texas GulfLink plans to employ submerged fill to control emissions during loading.

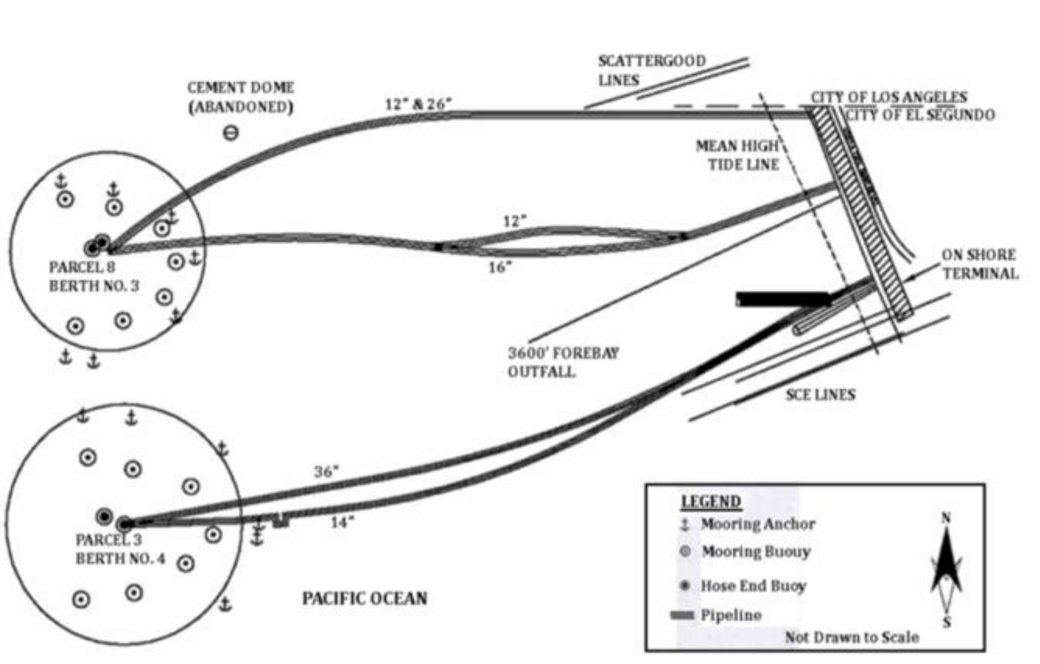
E. Ellwood Marine Terminal, Avon CA.

The Ellwood Marine Terminal was a near-shore (approximately 2,600 feet from shore), multi-buoy mooring facility with loading that used dedicated barges (the Olympic Spirit and the Jovolan) equipped with onboard vapor recovery units that limited the loading rate to 6,000 bph. Cargo loading was performed via a 10-inch rigid subsea pipeline and 240-foot floating hose. The facility ceased operating in 2012. The offshore portion of the terminal consisted of an irregular six-point mooring system in approximately 60 feet of water. Barges were loaded at the terminal with crude oil produced from Platform Holly that had been delivered to storage tanks at the onshore terminal. The barges then delivered the oil to market facilities in Long Beach Harbor and the San Francisco Bay area.

Unlike the Ellwood Marine Terminal, Texas GulfLink will be located offshore in deep, unprotected waters. Barges with onboard vapor recovery control will not be able to safely berth and discharge in unprotected water with weathervane moorings. The extreme operating conditions are beyond safe limits for barge operations. Texas GulfLink's loading rate will more than 10 times the rate of the Ellwood facility with Texas GulfLink averaging 60,000 bph (and an 85,000 bph maximum).

F. El Segundo Marine Terminal, CA.

El Segundo employed two different methods of Vapor Recovery but did not have any facility vapor processing capability. The El Segundo terminal is a near-shore, multi-buoy mooring located 1.5 miles offshore. The first method used a dedicated third-party vapor processing barge moored alongside other non-vapor recovery equipped barges. Vapor recovery limits the loading rate to approximately 11,000 bph. This vapor recovery barge is the only third-party processing barge deployed in the United States. It requires fixed mooring and has an operating limit of 6-foot seas and 36-knot winds. The second method utilized dedicated tankers (Mississippi Voyager and the Florida Voyager) are equipped with onboard canister-type vapor emission capture systems rated at 15,000 bph. The terminal has two open-ocean berths where tankers anchor and are tied off to moorings and oil is subsequently transferred to the onshore refinery via floating hose and subsea pipelines. Exports of the refinery include refined petroleum products and components such as diesel fuel, gas oil, number 6 fuel oil, commercial jet fuel, fluidized catalytic cracker light cycle oil, crude oil residuum, motor gasoline, and motor gasoline components. A flexible hose connects the PLEM to the vessel. Once the vessel is secured to the mooring buoys at the berth, the flexible hose is lifted from the bottom of the bay, connected to the vessel, pressure tested prior to loading and unloading the oil. The directions of wind, wave and current are aligned along one (1) prevalent direction.


SCATTERGOOD LINES
CEMENT DOME (ABANDONED)
12" & 26"
CITY OF LOS ANGELES
CITY OF EL SEGUNDO
MEAN HIGH TIDE LINE
12"
16"
PARCEL 8 BERTH NO. 3
ON SHORE TERMINAL
3600' FOREBAY OUTFALL
SCE LINES
36"
14"
PARCEL 3 BERTH NO. 4
PACIFIC OCEAN
LEGEND
Mooring Anchor
Mooring Buouy
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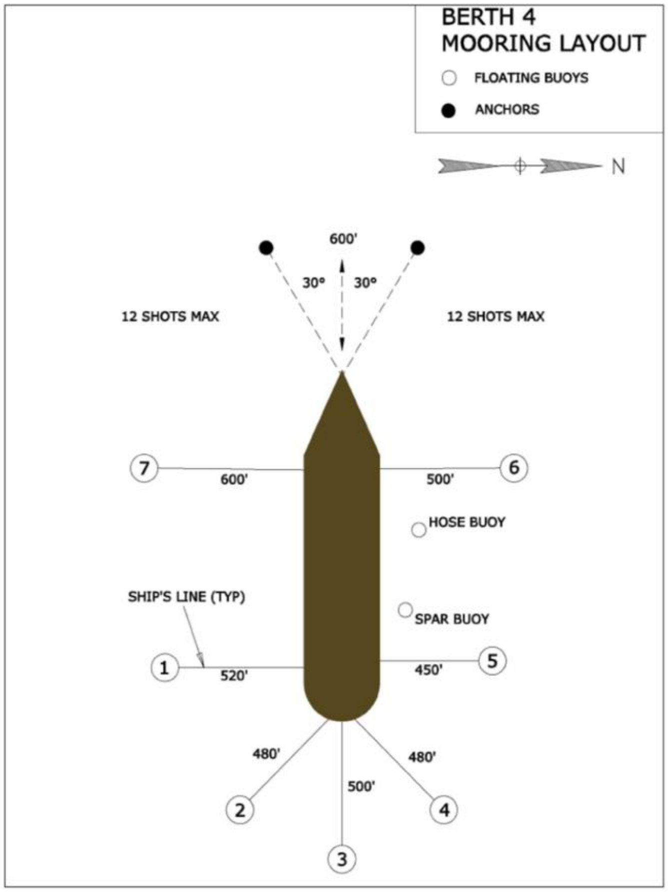
N
S
Not Drawn to Scale

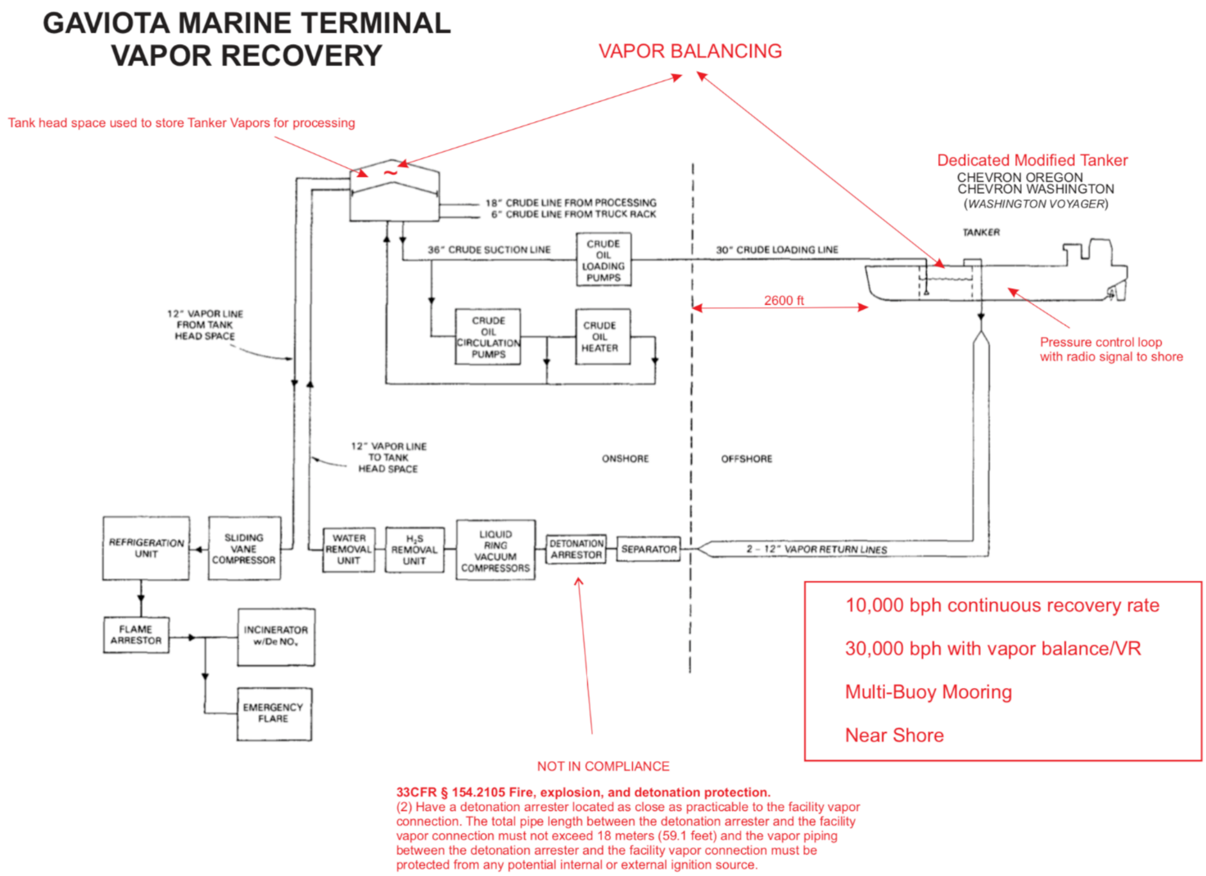
El Segundo Marine Terminal



Unlike the El Segundo terminal, Texas GulfLink will be located 28 miles from shore in 104 ft of unprotected waters. The tankers at GulfLink will not be moored in a conventional or fixed mooring arrangement but will weathervane (moving with the currents and prevailing winds) around the CALM SPMs and loading operations will take place in up to 14-foot seas and 44-knot winds—far more than the operational limits at El Segundo. The directions of wind, wave, and current are aligned along one prevalent direction at El Segundo, adding to the feasibility of using a third-party barge made fast alongside. Barges cannot operate in unprotected waters especially at Texas GulfLink's operating limits and at a minimum would require a stationary mooring arrangement. Furthermore, all or most of the third-party owned and operated VLCCs mooring at Texas GulfLink's CALM SPMs will not be outfitted with vapor recovery. Texas GulfLink's loading rate will be more than 5 times the rate of the El Segundo facility with Texas GulfLink averaging 60,000 bph (and an 85,000 bph maximum). It is not possible to retrofit the world's VLCC fleet (~700 tankers) with vapor recovery systems for processing emissions on board. Crude oil traders charter from the available VLCC fleet freely for economic reasons and taking into account worldwide trading routes.

G. Gaviota Marine Terminal, Santa Barbara, CA.

Gaviota is was a multi-buoy mooring terminal located near shore (only 2,600 feet from shore) in 65 feet of water. Vapor recovery requires two dedicated tankers fitted with special vapor recovery equipment to facilitate combined VRU and vapor balancing at the facility. A pressure control loop and a telemetry unit are required on the dedicated tanker. The head space above the shore tank balances with the tanker's empty cargo space. Continuous vapor recovery limits loading to 10,000 bph employing two 12-inch subsea vapor lines. Operating limits are 6-foot seas and 36-knot winds. The Gaviota Marine Terminal Facility was decommissioned in 1991 after only six months of operation. Gaviota is the only marine loading facility to use a subsea vapor hose and pipeline. The Gaviota marine terminal's vapor recovery system was complex with several components required to make it functional. These components included vapor balancing, vapor destruction, and dedicated tankers.



Comparing Gaviota to Texas GulfLink, Texas GulfLink will operate much farther from shore (28 miles), in deeper, unprotected waters (104 feet). Gaviota picked their vapor hose off the sea bottom, then connected them to the tanker's vapor connection. This method of controlling the vapor hose requires a conventional, stationary mooring unlike Texas GulfLink where tankers will weathervane around an SPM. Texas GulfLink will operate at much higher loading capacity—more than 6 times that of Gaviota on average, and Texas GulfLink's customers will use VLCCs that are unlikely to be specially outfitted with vapor recovery capabilities. Texas GulfLink shore tanks are 40+ miles away, making the vapor balancing component of Gaviota's system impossible. Gaviota's detonation arrestor was not USCG compliant by today's code of federal regulations. Gaviota's vapor recovery system in a fixed mooring, which required a combination of vapor balancing, vapor destruction, and dedicated tankers cannot be implemented at a Deepwater Port located in unprotected water, 28 miles offshore, weathervane mooring arrangement, with a VLCC pool of 700 plus Tankers which trade world-wide will not have the required dedicated equipment

H. San Barbara, CA, Santa Ynez Oil Field.

A floating offshore storage and treatment ("OS&T") Single Anchor Leg Mooring (tension mooring) SPM vessel moored in 490 feet of water received oil from the nearby Hondo production platform. A dedicated fleet of five 46,000 DWT tankers (the Exxon Jamestown, Lexington, Washington, Baltimore, and Boston) transported oil from the OS&T to the Gulf Coast and West Coast refineries. These dedicated tankers were specially designed with compressors to push the vapors through floating hoses to the OS&T for processing. Ten (10) psig was required to transfer the vapors approximately 300 feet in an 8-inch vapor line. Vapor recovery limited the loading rate 25,000 bph. The facility was operated from 1981-1993.

Unlike Texas GulfLink, the Hondo OS&T had five dedicated and specially outfitted tankers that could generate 10 psig to move vapors just 300 feet to the OS&T. If Texas GulfLink is required to conduct vapor recovery/vapor combustion, it will have only 1.6 psig available to move vapors through a 24-inch diameter flexible hose more than 1,200 feet from the tankers to the SPM and then another approximately 1.25 nm through a 42-inch diameter rigid steel pipe from the SPM to the platform, where the vapor combustion unit presumably would be housed. Furthermore, loading rates for the proposed Texas GulfLink are more than double that achieved at the Hondo OS&T.

I. GOLA (Galveston Offshore Lightering Area) Reverse Lightering.

VLCCs typically reverse lighter to fully load, often requiring four (4) AfraMax tankers to load a VLCC with up to a 2,000,000-bbl capacity. The AfraMax tankers load in the Gulf Coast ports of Corpus Christi, Freeport, Houston, Texas City, Brownsville, Point Comfort, and Beaumont, which in turn impacts port congestion and local air quality. An average time of eight (8) days is required to complete the reverse lightering process for a VLCC. Loading rates are approximately 60,000 bph. Vapor balancing is not employed during reverse lightering operations. Reverse lightering may also be combined with partial shore-side loading, where approximately 1 million bbls of product may be loaded inshore prior to leaving the port facility and thus reducing the number of lightering trips required. The Galveston Offshore Lightering Area (GOLA) is only 20 miles east of Texas GulfLink's proposed deepwater port, and GOLA loading operations are not required to employ vapor recovery, destruction, or balancing.

An estimate of emissions reductions achieved by Texas GulfLink by eliminating the number of reverse lightering trips required to export the same volume of oil is discussed in Section 2.3.

J. Delaware River.

Lightering operations represented the single, largest VOC point source listed amongst the 131 point sources in Delaware's 2002 Emissions Inventory. It was also estimated that nearly 200 tons of HAPs were emitted during those lightering operations. As a result, the Delaware Department of Natural Resources and Environmental Control Division of Air Quality drafted and promulgated rules requiring vapor balancing during crude oil vessel lightering operations. These rules, codified in Regulation No. 1124 - Control of Volatile Organic Compound Emissions, became effective May 11, 2007.

Unlike Texas Gulflink, the lightering operations used vapor balancing between two tankers with a short suspended flexible vapor hose, less than 200 ft. in length. Texas Gulflink's shore tanks are over 40 nm away from the SPM, requiring more than 30nm of subsea vapor pipelines and 1200ft of floating vapor hoses making the vapor balancing unachievable.

K. Louisiana Offshore Oil Port ("LOOP"), Gulf of Mexico.

LOOP has been operating for over 30 years with more than 10,000 tanker calls. LOOP employs three SALM-type SPMs located 20 miles offshore of Grand Isle (GI-59). A 48-inch bi-directional pipeline transports oil to/from an onshore facility. LOOP has been loading VLCCs for crude oil export since February 2018 using submerged fill with a VOC Management Plan with approximately 25 tankers loaded to date. No vapor recovery is available at the facility. It employs subsea crude oil pipelines, floating hoses, a manned platform and SPMs in unprotected waters. The distance from SPM to the platform is 1.3 nm—a distance that allows safe unmooring under extreme conditions and provides a distance for emergency response and corrective action should a VLCC lose power or steering. It also allows time (distance) to react to a breakaway from the SPM and prevent a platform strike. This distance is almost identical to the 1.25-nm distance proposed at Texas GulfLink. **LOOP is the only similar source to Texas GulfLink and controls emissions using submerged fill with VOC management.**

L. North Sea Dedicated Shuttle Tankers.

These dedicated shuttle tankers lead the world in the number of onboard vapor recovery processing systems. In Europe, crude oil loading is mostly confined to the North Sea, Scotland and Norway with a small amount of trans-shipment taking place in some northern European ports such as Rotterdam. Shuttle tankers are used for some fixed platforms and for all floating production, storage and offtake ("FPSO") vessels. The dedicated tankers are specially outfitted with vapor recovery units unlike the third-party owned VLCC tankers that Texas GulfLink will receive.

Summary of Similar Sources in the Marine Loading Industry

Table 3.2 summarizes the characteristics of the different terminals and deepwater ports and the types of control technologies employed at those facilities and compares them to Texas GulfLink. The table highlights the differences in design and function and demonstrates that none, except LOOP, are in fact similar sources. At the Hondo OS&T facility, the OS&T was moored to the SALM SPM and the tanker was moored to the OS&T. Additionally, the Hondo vapor system required OS&T vapor recovery and specially modified and dedicated tankers. Gaviota used a combination of vapor balancing, vapor destruction, and specially modified tankers. El Segundo has two separate vapor recovery methods; however, the facility is near shore in protected waters, requires fixed mooring and has an operating limit of 6-foot seas and 36 knot winds. Both vapor recovery methods required dedicated vapor recovery system placed onboard the tankers or barge. The Riverhead and Christy Lee facilities utilize platforms to provide fixed moorings, thereby making vapor recovery technically feasible – although Riverhead demonstrated that vapor control was not economically reasonable. Christy Lee did not have a facility Vapor Recovery but used dedicated tankers.

Table 3-2 Comparing Texas GulfLink with other DWPs, Loading Terminals, and Lightering

DWP or Terminal	*TGL*	El Segundo	Richmond Long Wharf	Hondo OS&T	Gaviota CA	Riverhead, NY	Christy Lee Platform, Drift River, AK	*LOOP*	GOLA Reverse Lightering
Mooring Method	**SPM**	Multi-Buoy	Fixed Jetty	Ship-Ship	Multi-Buoy	Platform	Platform	**SPM**	Ship-Ship
Weathervane	√			√				√	√
Distance offshore	**28 nm**	1.5 nm	< 2 nm	5.1 nm	½ nm	1 nm	2 nm	**20 nm**	30+ nm
Water Depth	**104 ft**	76 ft	52 ft	500 ft	65 ft	65 ft	80 ft	**115 ft**	100+
Sea State	**unprotected**	protected	protected	unprotected	protected	protected	protected	**unprotected**	unprotected
Max Tanker Class	**VLCC**	SUEZMAX	SUEZMAX	HANDYMAX	HANDYMAX	VLCC	HANDYMAX	**VLCC**	VLCC
Subsea cargo lines	√	√			√	√	√	√	
Floating Hose	√	√		√	√			√	
Facility Vapor Recovery			√	√	√				
Tanker Vapor Recovery		√		√	√				
Standalone Vapor Recovery Barge		√							

Of these facilities listed in Table 3-2, only three have the capability to load VLCCs. Those three (3) are identified in Table 3-3 below:

Table 3-3 US Crude Oil Loading Operations Currently Servicing VLCCs Without Vapor Recovery

Facility	Tanker Class	Mooring	Vapor Recovery	Submerged Fill with VOC Management
LOOP, GI-59	VLCC	SPM	NO	YES
River Head, NY	VLCC	Platform	NO	YES
GOLA Reverse Lightering	VLCC	Ship-to-Ship	NO	YES

When all the information is analyzed, LOOP is the only source similar to Texas GulfLink's proposed deepwater port.

3.2 Regulations for Similar Sources

The EPA has promulgated a variety of control technology standards in recent years for area sources (sources emitting less than 10 tons per year of any one HAP and less than 25 tons per year total HAPs) and major sources (sources emitting 10 tons per year or more of any one HAP and 25 tons per year or more total HAPs). Texas GulfLink's proposed deepwater port will be a major source of HAPs based on VOC emissions; however, as discussed in greater detail in Section 4.1 below, this facility does not meet the applicability requirements for the one source category that has currently been selected by EPA for regulation - marine tank vessel loading operations regulated under 40 CFR 63 Subpart Y ("Subpart Y").

4.0 Case-by-Case MACT Analysis

As indicated above in Section 3.1, LOOP is the only source that is similar in operations to the proposed Texas GulfLink deepwater port facility. LOOP was constructed and began operations prior to 1980, before the establishment of Subpart Y. LOOP controls VOC emissions from loading by utilizing submerged fill in conjunction with a VOC Management Plan. This demonstrated, achieved practice should be considered the MACT "floor" for this case-by-case MACT analysis.

4.1 Applicability of Clean Air Act §112(g) Requirements

Operation of the Texas GulfLink project will result in the emission of HAPs at levels that make the project a major source of air emissions and subject to regulation by EPA. CAA Section 112 authorizes EPA to regulate the emission of HAPs. CAA Section 112(d) requires EPA to promulgate regulations establishing emission standards for each category or subcategory of major sources listed by EPA under Section 112(c) of the CAA ("Listed Sources"). The emission standards for Listed Sources are referred to as National Emission Standards for Hazardous Air Pollutants ("NESHAP").

The NESHAP establish MACT standards for setting emissions limits for new and existing Listed Sources. In those instances where EPA has not established a MACT standard applicable to a major source of HAPs (i.e. for sources that are not a Listed Source), CAA section 112(g) applies. Under section 112(g), the MACT emission limitation is developed on a "case-by-case" basis.

MACT for new sources (whether listed under 112(c) or not) is defined in 40 CFR §63.41 as follows:

> Maximum achievable control technology (MACT) emission limitation for new sources means the emission limitation which is not less stringent than the emission limitation achieved in practice by the best controlled similar source, and which reflects the maximum degree of reduction in emissions that the permitting authority, taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements, determines is achievable by the constructed or reconstructed major source.

In 1995, EPA promulgated a specific MACT standard for HAP emissions from marine tank vessel loading operations—a Listed Source—under Subpart Y. Under Subpart Y, new, major offshore loading terminals are required to reduce HAP emissions from marine tank vessel loading operations by 95 weight-percent.[2] HAP emissions can be controlled using one of two primary methods: vapor combustion (“VC”) or vapor recovery (“VR”). 59 FR 25004, 25007 (May 13, 1994).

The 1995-adopted NESHAP set MACT standards for several subcategories of the marine tank loading operations category, including new major source offshore terminals. Based on comments received during the rule-making, EPA determined there were no more than 20 offshore terminals with subsea liquid loading lines (i.e. lines that run along the sea floor rather than on piers or docks) in existence. 60 FR 48388, 48393 (September 19, 1995). None of those terminals captured and controlled emissions from marine tank vessel loading, either with subsea or surface vapor lines. 60 FR 48388, 48393 (September 19, 1995). After analyzing the small amount of available information on available technology, EPA determined that no control was the MACT floor for existing offshore terminals.

In 1995, EPA was made aware of only two offshore terminals, both lacking subsea lines, that were controlling emissions at that time. 60 FR 48388, 48393 (September 19, 1995). However, EPA did not have any information regarding the specific control techniques used at these two terminals. 60 FR 48388, 48393 (September 19, 1995). While EPA stated it was aware there were additional offshore terminals without subsea lines, it was unable to quantify the total number in existence.

For new sources (as opposed to existing ones), CAA Section 112(d)(3) provides that the MACT floor “shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source.” Although EPA had little to no information at its disposal regarding the control techniques at the two controlled offshore terminals without subsea lines and had not identified any controlled offshore terminals with subsea lines, EPA determined that “the best controlled similar source achieves a 95 percent reduction of controlled emissions. The resulting MACT floor for new offshore major sources is therefore a 95 percent reduction in HAP emissions.” 60 FR 48388, 48395 (September 19, 1995). At a minimum, sources like Texas GulfLink are not similar to the two controlled facilities as each lacked subsea lines and are therefore not part of the subcategory used to establish the new source MACT standard.

In a 2008 proposal, EPA stated that it had not identified any advancements in practices, processes, and control technologies for marine tank loading operations. 73 FR 60432, 60457 (October 10, 2008). In a 2010 supplemental proposal, EPA stated that vapor collection and processors (recovery) was a possible control for certain marine tank loading operations involving gasoline loading. 75 FR 65068, 65115 (October 21, 2010). Ultimately in the rule amendment adopted in 2011, EPA determined that vapor recovery was not cost-effective and only required existing offshore terminals to use submerged fill, which EPA identified as the MACT floor level of control. 76 FR 22566, 22571 (April 21, 2011). By authorizing submerged loading for existing offshore sources, EPA recognized it as a viable option for controlling emissions. However, EPA still did not consider sources like the proposed Texas GulfLink deepwater port facility because facilities such as LOOP were not loading ships with capacities such as VLCCs. Further, EPA did not consider how the presence or lack of subsea lines might impact the ability to deploy vapor recovery and the associated safety issues when vapors are transported in rigid pipelines or flexible lines for long distances in deep water.

Texas GulfLink's proposed loading of tankers by transporting crude oil via subsea lines to a manned platform, then from the platform to two PLEMs located on the sea floor, then from the PLEMs via flexible hose to two SPM buoy systems at the surface, and then from floating cargo hoses at the SPMs to the tankers, does not fit within any of the source categories or subcategories evaluated during the Subpart Y rulemaking process. The lack of representative sources similar to Texas GulfLink's proposed crude oil exporting facility is unsurprising, as no similar facilities existed at the time EPA adopted Subpart Y in 1995 or when it amended Subpart Y in 2011. No demand existed for these facilities because crude oil exports from the United States were banned from 1975 to 2015 under the 1975 Energy Policy & Conservation Act.

Importantly, Texas GulfLink's proposed deepwater port does not meet the definition of "offshore loading terminal" as that term is defined by EPA regulations in Subpart Y. Subpart Y defines an "offshore loading terminal" in 40 CFR §63.561 as follows:

> Offshore loading terminal means a location that has at least one loading berth that is 0.81 km (0.5 miles) or more from the shore that is used for ***mooring*** a marine tank vessel and loading liquids from shore. (emphasis added)

A critical part of the definition of an offshore loading terminal is the need for at least one "loading berth." The term "loading berth" is defined as follows:

> Loading berth means the loading arms, pumps, meters, shutoff valves, relief valves, and other piping and ***valves necessary to fill marine tank vessels.*** The loading berth includes those items ***necessary for an offshore loading terminal***. (emphasis added).

Finally, a "terminal" is defined as "all loading berths at any land or sea-based structure(s) that loads liquids in bulk onto marine tank vessels." Based on these definitions, an *offshore* loading terminal subject to Subpart Y requires at least one loading berth at a sea-based structure. The Texas GulfLink project is not an offshore loading terminal as contemplated by these definitions.

The Texas GulfLink deepwater port will load tankers using an SPM buoy system. The tankers are physically moored to the floating SPMs, not any platform. Once a ship is moored to the SPM, the oil is loaded directly into the crude oil tankers using 1,200-foot flexible hoses. The equipment "necessary" for Texas GulfLink to "fill marine tank vessels" or to "load liquids in bulk" include the pumps (located and controlled onshore), the subsea pipeline, the PLEMs, the SPMs, and the 1,200-foot flexible hoses connecting the SPMs to the tankers. There are no "loading arms" or "pumps" at the SPM, only the lengthy floating flexible cargo hoses. The SPM-system proposed by Texas GulfLink does not fall within the meaning of a "loading berth."

Although part of the overall design of the Texas GulfLink project, the offshore fixed platform is not necessary for loading operations and not a loading berth. The flow of oil from shore to the tankers is driven by five (5), 5000 horsepower (hp) pumps (with three (3), 2000 hp boosters) located onshore and fully controlled from an onshore control room—not the platform. Likewise, system shut-off valves are located onshore downstream of the main pumps. There are no "loading arms" or "pumps" on the platform itself. In fact, no equipment critical to loading is located solely on the platform. The platform itself is 1.25 nautical miles (1.43 miles) away from the SPM buoys where the tankers are moored.

While all deepwater port applicants propose to load tankers in the same manner – via an SPM system, some deepwater port applicants, like Texas GulfLink, recognize the benefits of incorporating a platform (at significant additional cost) into their projects. The platform provides support in the event of a discharge, accident, pipeline surge, or security event. The platform is not necessary to the loading operation conducted through the SPM, as evidenced by the applicants that propose an SPM-only port facility. In all loading operations, the tanker's person in charge communicates directly with shore-side control room oil movement controllers, not platform personnel.

Because the platform does not constitute a "loading berth" and because the DWP project proposed by Texas GulfLink does not fit within the meaning of an "offshore loading terminal" as those terms are defined in Subpart Y, a case-by-case MACT under CAA 112(g) analysis is the technically and legally more appropriate approach for establishing an emissions limit. Further, under a case-by-case analysis, the Texas GulfLink project can be evaluated based on the unique aspects of its proposed design while taking into account the safety and operational issues highlighted in Section 4.2.

4.2 Feasibility of Available Control Technology

The technology for vapor recovery at a deepwater port with a CALM SPM is not available at present. The technology is conceptual and unproven. There are over 400 CALM buoys in the world; however, none are fitted/retrofitted with vapor recovery. Additionally, the USCG would have to approve any new design concept. 33 CFR § 154.2020**.** The operational reliability and performance have not been demonstrated by approved methods under representative conditions. Copies of correspondence between Texas GulfLink representatives and control technology vendors such as John Zink documenting the technical infeasibility of retrofitting CALM buoys is available upon request to the EPA.

The following technical issues prevent effective utilization of available vapor recovery methods for offshore marine loading and unloading operations:

- **CALM Buoy P-Trap Concerns**: There is a p-trap between the tanker's vapor manifold header and the CALM Buoy where liquid drop-out will accumulate. The approximate pressure to lift any liquid over the CALM Buoy would be approximately 4 psi, well above the 3.6 psi structural damage pressure limitation of the tanker.
- **Vapor Line Total Length of 9,139 ft:** The combined length of vapor pipe and hoses between any proposed vapor destruction unit and the tanker's vapor manifold presents a unique regulatory challenge because of safety and engineering considerations to draw vapors at this length through subsea lines and floating hoses. The vacuum required by the platform compressors is excessive and near impossible to overcome. The 1.25-nm SPM distance is essential for safe port operations design. Refer to Figure 6, in attachments, for a diagram showing the vapor recovery lines for Texas GulfLink.
- **Detonation Arrester ("DA"):** The DA is a fail-safe device to protect the tanker from flame propagation. The platform location is 9,139+ feet from the tanker by vapor connection. In accordance with regulation 33 CFR §154.2105, the maximum distance allowed for a DA is 59 feet from the tanker. So the platform is not an acceptable location for the DA from either a technical or regulatory perspective. The CALM buoy swivel seals and flange connections may be under a vacuum and are subject to leaking. A leak could allow fresh air intake as well as produce a static charge, which could result in an explosion. Any sump to address liquid drop-out in the subsea vapor pipelines and hoses will be outside of the DA. The DA placed anywhere but immediately alongside the tanker will put the tanker and its crew at risk. There is no room on the tanker's manifold deck area to place a DA.
- **Low Point(s) in Vapor Pipeline:** A sump device will have to be designed to address liquid drop-out in the vapor pipelines near the PLEM. The reliability and operation of the sump system at 104 ft water depth will be an engineering challenge for service, inspection and reliability. The sump would have to be buried below the pipelines to collect the liquid and pump it to the platform for processing.
- **Floating Vapor Hoses:** The floating vapor hose buoyancy characteristics are significantly different than that of a liquid-filled cargo hose. The lighter vapor hose will float higher in the water and have a tendency to ride over the cargo hose when pulling the hoses out for mooring and unmooring. Mooring operations are critical, and a hose tangle will stop

operations when the tanker is in close proximity to the SPM. Floating hoses are subject to kinking and tearing. Subsea riser hoses will react radically different in seas causing rubbing and possible fouling between the PLEM and SPM. The subsea riser hose under a vacuum will be subject to collapse at the 104-foot water depth pressure.

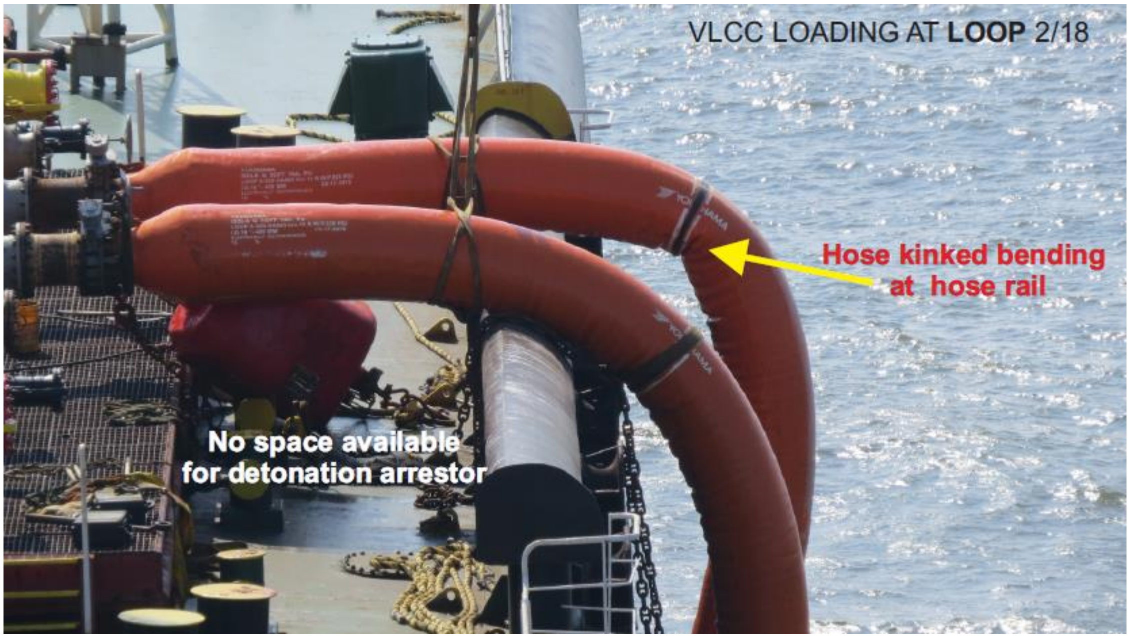


Photo 4-1: Indication of hose kinking on a VLCC, offshore Louisiana. *(Note: No space available for detonation arrestor)*

- **Liquid Drop-out:** Liquid drop-out will accumulate and will need to be addressed. The inherent design in the tanker's inert gas system will saturate the vapor content in cargo the tanks with moisture. The temperature differential between the vapors and the surrounding seas will cause liquid drop-out. Multiple dips in the floating hoses when conforming to seas (operating conditions to 12-foot seas) will contribute to pocketing of liquid along the 1,100-foot length. The weathervane motion of the tanker around the SPM will allow the sea motion to drive the liquid in the floating hose aft, towards the stern of the tanker. Sloshing between dips in low points in the hose will occur causing reduction in throughput capacity and total blockage at times. Surges in pressure will impact the tanker as this occurs. In the latter stages of loading, this creates significant safety risks to tanker, cargo and, most importantly, the crew. There is no method for draining, pigging, or monitoring any liquid in the floating hoses. Subsequent loads will experience a cumulative effect from the liquid drop-out. The tanker will be operating at 80% pressure setting of the p/v valves, leaving little room for pressure spikes before lifting.

- **Cargo Tank Pressure:** The tanker's VOC Management Plan recommends operating between 70 to 80% (1.4 to 1.6 psi) of the pressure vacuum valve setting to reduce VOC generation in the cargo tanks. Any pressure spikes from liquid blockage or kinking of the vapor hose will put the tanker at risk of unintentional venting on deck or, worst-case, structural damage thus creating significant safety risks to tanker, cargo and, most importantly, the crew. In the final 10 to 15% stage of loading, where the vapor space in the cargo tanks is relatively small, pressure spikes will be amplified. At a 2.0 psi mechanical p/v setting, individual tank p/v valves lift, which would expose the crew on deck to vented hydrocarbon vapors. The tankers will load to 98.5% capacity leaving only 1.5% vapor space upon completion of loading. A chart that illustrates pressure relief valve settings and structural damage operating limits for cargo tanks is shown in Figure 7.
- **Compressor Vacuum:** Pressure drop in the 9,139-ft vapor line from the tanker will require a substantial vacuum to pull vapors from the tanker. The maximum 16-inch CALM buoy swivel connection and rail tail floating hoses will factor into this equation. Formation of ice in lines due to adiabatic expansion when pressure is reduced could be possible. Regulation 33 CFR §154.2103 ("Facility Requirements for Vessel Overpressure and Vacuum Protection") addresses this issue. Vacuum hazards must be taken into consideration.
- **CALM Buoy:** Presently there are no CALM buoys in operation with a vapor connection. The flanges and swivel connection of the vapor line in the CALM buoy, which may be in a vacuum state, could be leak sources. Fresh air will be drawn in making small leaks difficult to detect and dangerous as the fresh air will mix with the hydrocarbon vapors present in the lines. An explosion at the CALM buoy would instantly rupture the cargo hoses, igniting a large fire. A ruptured vapor hose will supply hydrocarbon vapors to the fire until the tanker's crew can close off the manual vapor header valve at the manifold. Cargo oil will be escaping from the ruptured cargo hoses until the flow can be stopped.
- **Propane:** Propane is a highly flammable gas, would need to be used to supplement a vapor combustion/control device during the initial stages of tanker loading. The storage and use of flammable gasses on a manned platform are inherently dangerous for personnel working and living in close proximity to these substances. This unnecessarily increases risks in an environment where fires/explosions and gas releases contribute to

approximately 20-25 percent of all platform incidents each year. Additionally, resupplying would need to be accomplished by frequent deliveries using portable bottles. The transfer of the bottles will be by support boats that will be working in sea conditions that can be less than ideal.

The above-listed technical issues prevent vapor recovery at the proposed Texas GulfLink deepwater port facility from both an engineering and safety standpoint. Vapor balancing is not achievable as Texas GulfLink's shore tanks are about 40 miles away. Weathervane mooring rotation, in unprotected waters, prevents any third-party vapor processing barge from mooring. The only demonstrated achievable control technology applicable to Texas GulfLink is utilizing submerged fill while implementing a well-developed VOC Management Plan with appropriate monitoring and record keeping. Any tankers fitted with onboard vapor processing units would be required to utilize their processing systems while loading at Texas GulfLink.

4.3 Evaluation of Other Commercially Available Control Technologies

In response to EPA's August 2, 2019, comment letter, Texas GulfLink also considered potentially transferrable control technologies. There are five different types of emission sources that EPA identified in the December 27, 1996 preamble to the CAA 112(g) final rule.[5] The emission source most applicable to the Texas GulfLink DWP is the "Transfer Losses" emission source. The Transfer Loss emission source is described as "emission of an organic liquid, gas, fume, vapor or particulate resulting from the agitation of material during transfer or the material from one unit to another." The preamble then identifies some examples of activities within this category as "filling of mobile tanks, dumping of coke into coke quench cars, transfer of coal from bunker into larry car, emptying of baghouse hoppers, and sludge transfer."[6]

The range of sources that fall within the Transfer Losses emission source category is broad. However, just because two sources fall within the same source category does not mean that the emission points can be controlled using the same type of control technology. For example, the

[5] 61 F.R. 68384, 68394 (December 27, 1996).
[6] Id.

control technology used for controlling emissions during the transfer of coke or coal (e.g. emissions of particulate matter) is not likely to be the same technology used to control emissions during the transfer of crude oil (e.g. vapor emissions). In order to make sure potentially transferrable technologies were considered in the MACT analysis, Texas GulfLink reviewed other control technologies implemented at other sources within the broader Transfer Losses emission source category and at the sources identified by Texas GulfLink as potentially similar.

Texas GulfLink analyzed the following emission control technologies as potentially transferable or employed at potentially similar sources:

- Vapor Balancing
- Barge with Vapor Recovery Processing On-Board
- Tanker with Vapor Recovery Processing On-Board
- Dedicated Vessel with Vapor Recovery
- Vapor Recovery and Combustion
- Submerged Fill with VOC Management Plan

Each of these emissions control technologies will be discussed in more detail below, but the results of the analysis are summarized in Table 4-1.

Table 4-1 Analyzing Possible Transfer Loss Control Technologies

Control Technology	Operational Constraints at Deepwater Ports	Proven Technology	Achievable at TGL
Vapor Balancing	Requires two tankers or one (1) tanker and one (1) facility storage tank for balancing	Yes	No
Barge with VR processing installed onboard	Limited size <100,000 bbls, requires protected waters, limited recovery rate < 15,000 bph, operating limit <6 ft seas.	Yes	No
Tanker with VR processing installed onboard	Limited number of equipped tankers world-wide. Only Shuttle Tankers and Handy Tankers fitted, no VLCCs. North Sea Dedicated Service Fleet of VR equipped tankers with processing system onboard not available for US charter. VLCC fleet is comprised of approx.700 third-party tankers that do not currently have VR and are outside of TGL's control.	Yes	No
Dedicated Vessel with Vapor Recovery System moored alongside barge at facility	Requires protected waters, stationary mooring system, weather limitations, limited processing capacity, only one (1) third-party barge (San Pedro) in U.S., 11,000 bph continuous recovery rate. Barge-to-barge use only, operating limit <6 ft seas.	Yes	No
Vapor Recovery & Combustion at the facility	Multiple issues with vapor recovery using floating hoses including navigational hazards and technical infeasibilities, Detonation Arrestor location and required distance, Manned Platform VDU location and propane fuel storage, limited distance compressor vacuum can be effective. Unproven technology, none in operation world-wide at an SPM. Requires USCG approval.	Yes	No
Submerged Fill with VOC Management Plan	Class approved Tankers VOC Plan specific to each Tanker.	Yes	Yes

Texas GulfLink evaluated how those control technologies are employed in practice and whether they were technically feasible to employ at the Texas GulfLink's proposed deepwater port.

A. Vapor Balancing

Description: Delaware River, lightering at anchor, ship-to-ship transfer with vapor balancing used to control emissions.

Analysis: Not similar in design to Texas GulfLink. The deepwater port has no platform storage tanks to balance vapors with the shore tanks ~40 nautical miles distant.

B. Crude Oil Barges < 100,000 bbls

Description: Dedicated vapor recovery equipment onboard Harley Marine Barges working primarily along West Coast, including at the Ellwood Marine Terminal.

- Jovalan: 55,000 bbl capacity with passive VR system installed onboard
- Olympic Spirit: 80,000 bbl capacity with active VR system installed onboard

The system that Glosten and Foss developed is considered passive in that the vapors are passed through a pair of canisters full of special carbon pellets that absorb the VOCs. Ron Costin, Foss's tank barge manager in Southern California, said they achieve a throughput of 450,000-500,000 barrels before the pellets are vacuumed out and replaced.

Analysis: Not similar in design or capacity to Texas GulfLink. Barge size is too small to be considered when evaluating vapor recovery for VLCC tankers: 80,000 bbl barge compared with 2,200,000 bbl VLCC (4% capacity of a VLCC) and recovery rate of 6,000 bph. The carbon canisters would require changing 4 times per load for a VLCC. Texas GulfLink will load up to 85,000 bph. Operating conditions in offshore, unprotected waters, like Texas Gulflink Deepwater Port, exceed the limits Barges can operate in.

C. Small Tankers < 25,000 DWT

Description: Dedicated vapor recovery equipment onboard (Avon Terminal, CA.) *Lion of California* 16,000 DWT.

Analysis: Not similar in design or capacity to Texas GulfLink. Tanker is too small to be considered when evaluating vapor recovery for VLCC tankers: 16,000 DWT compared with 320,000 DWT (5% DWT of VLCC).

D. Exxon Hondo OS&T

Description: Five dedicated Handy Tankers (Jamestown, Lexington, Baltimore, Washington and Boston), specially equipped for vapor recovery. Hondo OS&T facility is located in the Santa Barba Channel, Federal waters. Tankers are moored bow to bow with the OS&T Vessel (SPM SALM Moored). Compressors were mounted on the bow of the Handy Tankers to push the vapors back to the OS&T facility for processing at 10psi via approximately 300 ft of floating hose. Loading rate of 30,000 bph.

Analysis: Not similar in design or capacity to Texas GulfLink. Not possible to retrofit the worldwide VLCC fleet (approximately 700 tankers) with compressors or blowers on the tanker to deliver vapor emission to the GulfLink deepwater port platform for processing approximately 9000 feet away.

E. Handy Tankers: Chevron Oregon/Washington (Gaviota Marine Terminal)

Description: Specially designed, dedicated vapor recovery equipment onboard specifically for Gaviota Marine Terminal's vapor recovery system.

Analysis: Not similar in design or capacity to Texas GulfLink. The two Handy Tankers were fitted with specially designed onboard vapor recovery components for use only at Gaviota Marine Terminal and not compatible with the Texas GulfLink deepwater port or other marine loading terminals. Gaviota also incorporated vapor balancing when processing vapor emissions from the Tankers *Oregon* and *Washington*. Texas GulfLink has no platform storage tank to balance vapors between with the shore tanks approximately 40 nautical miles away. Gaviota was designed as a multi-buoy mooring with 3500 feet of subsea or floating vapor lines. Texas GulfLink has 9000+ feet of subsea or floating vapor lines. Gaviota's continuous vapor processing rate was 10,000 bph. Texas GulfLink's maximum loading rate is 85,000 bph. Gaviota only operated for a six-month period.

F. Handy Tankers: Mississippi Voyage and Florida Voyager

Description: Specially designed, dedicated vapor recovery system onboard Handy Tankers to process emissions (El Segundo Marine Terminal). Can process emissions at any loading port. Canister-type vapor recovery system rated at 15,000 bph. Currently operating on the United States West Coast today for Chevron.

Analysis: Not possible to retrofit the worldwide VLCC fleet (approximately 700 tankers) with vapor recovery system for processing emissions onboard. Traders charter from the available VLLC fleet freely for economic reasons and worldwide trading routes.

G. Third-Party Barge Processing Vapor Emissions.

Description: Processing of vapor emissions for barge loadings at El Segundo are achieved by mooring a dedicated 3rd party barge alongside the barge in the moorings, that is capable of processing vapors at a loading rate of up to 11,000 bph. The San Pedro barge is the only barge in the world identified that performs third-party vapor processing. The San Pedro is similar to the vapor-equipped barges but also has a condensate tank for separating out water before passing the vapors through the carbon canisters.

Analysis: Not similar in capacity to Texas GulfLink. Barge operations require protected waters and stationary moorings. Barges are too small to be considered when evaluating vapor recovery for VLCCs: 11,000 bph vs 85,000 bph loading rates (13% capacity). Texas GulfLink will be located 28.3 nm offshore in unprotected waters with a weathervane mooring system which is not suitable for barge operations.

H. Platform Mooring

Description: Drift River, AK, Christy Lee Platform. The tanker moors alongside the platform. The platform is equipped with no facility vapor recovery system and has fixed subsea pipelines and chiksan manifold connections. Dedicated Tankers fitted with Vapor Processing on board were used for loading operations.

Analysis: Not similar in design to Texas GulfLink. SPMs have subsea riser hoses (160 feet), floating marine hoses (1100 feet), swivel connection though the CALM Buoy, weathervane moorings and are located 28.3 nautical miles offshore in unprotected waters. Not possible to retrofit the worlds VLCC fleet (~ 700 tankers) with vapor recovery system for processing emissions onboard. Traders charter from the available VLLC fleet freely for economic reasons and worldwide trading routes.

I. Causeways, Jetties, and Dockside Terminals

Description: Numerous terminals, including Richmond Long Wharf, that have stationary mooring, protected waters, onshore or inshore, not capable of mooring a fully loaded VLCC, chiksan manifold connections, no subsea pipelines, Detonation Arrestor in compliant location, drop-out legs provided, and fixed pipelines for vapor recovery. Vapor recovery accomplished by proven design facility vapor recovery systems. (Hercules, CA was similar causeway but without vapor recovery and was decommissioned 1995).

Analysis: These facilities are not similar in design. Texas GulfLink deepwater port will be located 28.3 nm offshore in unprotected waters, have operating conditions to 12 foot seas and weathervane mooring arrangement, requires subsea pipelines and floating hoses, draining of liquid drop-out not achievable in floating vapor hoses, issues with Detonation Arrestor location (9000+ feet from Tanker), swivel CALM Buoy connections, in 104 feet of water, and designed primarily for VLCCs.

J. Vapor Recovery Return Line to Onshore Facility

Description: Facilities with fixed vapor return lines, such as Richmond Long Wharf, are terminals with fixed moorings to piers, jetties, or causeways allowing for fixed vapor connections and pipelines, have compliant detonation arrestors, drip legs, vapor moving devices near the tanker, and do not use floating or subsea hoses. The distance of the vapor return line is less than one mile and runs along the pier, jetty, causeway, or pipe trestle. There are no subsea vapor lines. Vapor recovery at this type of facility is proven control technology.

Analysis: Not similar in design. The Texas GulfLink deepwater port will be located 28.3 nm offshore in unprotected waters and will have a weathervane mooring arrangement, subsea pipelines, floating hoses, non-compliant detonation arrestor location and vapor connection by hose. The 28.3 nm for the vapor return line is too long of a run for a blower or compressor to be effective in moving the vapors ashore. Additionally, the liquid drop-out would be an unsurpassable obstacle at that distance despite pigging the lines.

4.4 Costs of Achieving Emission Reduction, Non-Air Quality Health & Environmental Impacts, and Energy Requirements Associated with the Emission Reduction

The MACT analysis also requires consideration of the costs of achieving emissions reduction and any non-air quality health and environmental impacts and energy requirements associated with the emission reduction. As discussed at length in Sections 2.2 and 4.2, vapor recovery at the platform or CALM buoy for an offshore deepwater port is not proven technology and is not a safe practice. Vapor balancing also poses significant feasibility hurdles. Of all of the means of emission control identified and subsequently evaluated, the only safe and technologically feasible means of control is an emissions control system mounted on the tanker. This practice is endorsed by OCIMF in its publication Volatile Organic Compound Emissions from Cargo Systems on Oil Tankers (February 2019). “If an oil tanker is loaded from a fixed production and storage platform or **floating facility through a loading buoy** or submerged turret, the VOC emission control methods and associated systems are **installed on the oil tanker**, if applicable”.

The cost to add vapor control (e.g. a combustion VEC) to a VLCC is approximately $4.6 million dollars (USD) for new build and between $8-10 million dollars for a retrofit because of the cost of taking the vessel out of service for 3 months. This does not take into account costs for fuel and labor for routine operations of the vapor control system, nor does it include costs for periodic maintenance and repairs. These costs could be up to $1 million per year per VLCC.

The worldwide VLCC tanker fleet is comprised of over 700 vessels. Texas GulfLink has no control over the installation of vapor control on third-party owned VLCCs.

Vapor control systems are now a standard practice on the North Sea Shuttle Tanker fleet, which performs lightering operations. Per Table 4-2 below, data indicates that the typical installation cost per ton of VOC reduced for a North Sea Shuttle Tanker is approximately $1,100. As North Sea Shuttle Tanker are typically 30% smaller than VLCCs, the expected installation cost per ton of VOC reduced is approximately $1,571.

Table 4-2 North Sea Shuttle Tanker cost of VOC Control Equipment (USD)

North Sea Shuttle Tanker		Comments
Loads per Year	32	Annual loadings per tanker
Tons VOC per Load	100	Per report 114 million tons are producing 114 Kilotons of VOC 1000 to 1 ratio
Total VOC emissions	3,200	Tons
Installation Cost per Ton	$ 1,100	
Installation of VOC Control Equipment	$ **3,520,000**	**Cost to Install VOC Control Equipment**

Source: Measures to Reduce Emissions of VOCs during Loading and Unloading of Ships in the EU, AEAT/ENV/R/0469 Issue 2, Howard J Rudd & Nikolas A Hill, August 2001.

5.0 Case-by-Case MACT Determination

5.1 Identified Control Approach that Achieves the Maximum Degree of HAP Emission Reduction

As stated throughout this document, 40 CFR §63.43(d) specifies the manner in which a case-by-case MACT analysis must be conducted. In adhering to those specifications, a comprehensive nationwide (and to a certain extent, worldwide) review was conducted to identify the maximum degree of HAP emissions reduction that is achieved at a similar source. While recognizing the limitations noted by EPA in attempting to identify similar sources, as well as the maximum degree of HAP emission reduction that is achieved in practice, the results of this case-by-case MACT analysis are consistent for the evaluation performed—the best controlled source similar to the proposed Texas GulfLink deepwater port employs submerged fill and a comprehensive VOC Management Plan. This conclusion is corroborated by review of data available from EPA's RACT/BACT/LAER Clearinghouse.

Pursuant to 40 CFR §63.43(e), an application for a MACT determination must specify a control technology that, if properly operated and maintained, will meet the MACT emission limitation or standard as determined according to the principles set forth in paragraph (d) of that section.

The data presented in Sections 3.1 and 4.2 clearly demonstrate that vapor recovery at a deepwater port employing SPMs is technologically infeasible, not been achieved in practice, and that the control technology used at the most similar sources to achieve the highest degree of HAP emission control employs submerged fill and a comprehensive VOC Management Plan. Accordingly, submerged fill under a VOC Management Plan should be considered the MACT control technology.

5.2 Proposed Operational/Monitoring Standards and Emission Control Plan

Pursuant to 40 CFR §63.43(d)(3), if the permitting authority (in this case, EPA) determines that it is not feasible to enforce a specific emissions limit, then it can approve a "specific design, equipment, work practice, or operational standard, or a combination thereof."

Additionally, EPA recognizes that control efficiencies across similar sources may be different. The permitting authority is expected to use its judgment in determining when operating conditions are comparable across emission units. (61 FR page 68395, Dec 27, 1996)

Vapor recovery at a deepwater port employing SPMs is technologically infeasible, not been achieved in practice, and the control technology used at the most similar sources to achieve the highest degree of HAP emission control is submerged fill and a comprehensive VOC Management Plan. Accordingly, Texas GulfLink is requesting approval from EPA to utilize submerged fill and employ a VOC Management Plan ("work practice") as the appropriate MACT control standard for its proposed deepwater port facility.

The VOC Management Plan is a ship-specific management plan designed to minimize VOC emissions during loading operations through best management practices and is an acceptable substitute for a specific emissions limit—especially after considering the safety issues discussed above in Section 4.2. Because VOC Management Plans are developed on a ship-specific basis, there is no specific emissions limit that can be prescribed under submerged loading. Rather, the emissions limit will vary depending on the specific size and design of the ship being loaded. Therefore, to control VOC emissions, it is appropriate to adopt ship-specific plans that comply with the standards and guidance set forth in *Resolution MEPC.185(59) – Guidelines for the Development of a VOC Management Plan*, which was promulgated by the Marine Environmental Protection Committee of the International Maritime Organization.

With respect to the loading operations at the proposed SPM buoy system, Rule 1.4 of MEPC.185(59) states that while maintaining the safety of the ship, the VOC Management Plan should encourage and set forth the following best management practices as appropriate:

- The loading procedures should take into account potential gas releases due to low pressure and, where possible, the routing of oil from crude oil manifolds into the tanks should be done so as to avoid or minimize excessive throttling and high flow velocity in pipes.
- The ship should define a target operating pressure for the cargo tanks. This pressure should be as high as safely possible and the ship should aim to maintain tanks at this level during the loading and carriage of relevant cargo.

- When venting to reduce tank pressure is required, the decrease in the pressure of the tanks should be as small as possible to maintain the tank pressure as high as possible.
- The amount of inert gas added should be minimized. Increasing tank pressure by adding inert gas does not prevent VOC release but it may increase venting and therefore increase VOC emissions.

A copy of Resolution MEPC.185(59) can be provided upon request.

Texas GulfLink has prepared a site-specific Best Management Plan specifying monitoring, recordkeeping, and reporting activities included in the Texas GulfLink Operations Manual in Section 28.2 VOC Emissions Reduction Policy and Sec 10.8 Cargo Transfer Assistant – 10.8.2 duties to ensure effective deployment of ship-based VOC Management Plans and compliance with applicable air quality requirements.

6.0 Conclusions

The proposed Texas GulfLink Project has been carefully designed to provide an efficient, safe, and environmentally responsible solution for large-scale petroleum exporting to international markets. The completed facility will be capable of fully loading VLCC vessels in an offshore environment for the purpose of exporting crude oil to international markets, while reducing overall VOC and NOx emissions that result from lightering operations currently conducted in many port areas of the United States.

In part because deepwater port facilities represent a relatively new subset of a MACT source category, EPA has not developed standards specific to these facilities, and a new major source of HAPs in the industry must apply for a case-by-case MACT determination. In addition each proposed deepwater port has its own unique design considerations that are best analyzed on an individual basis. This analysis satisfies this case-by-case MACT requirement. Texas GulfLink will comply with the proposed case-by-case MACT by implementing the equipment/operational emission limitations specified in this analysis. The HAP emission limitation at Texas GulfLink is the use of submerged fill under a comprehensive VOC Management Plan which will achieve the highest degree of HAP emission control. A nationwide search of similar facilities, including other known nearshore and offshore facilities, yielded results demonstrating that no more stringent emission limitation is achieved at any similar source. Expected emissions reductions, compared to lightering, of over 7,300 tons per year of VOC and over 220 tons per year of HAPs from the Texas GulfLink deepwater port prove that this project is an effective means of emissions control that provides significant environmental, safety and health benefits.

Establishing numeric emission limitations on the operations at the proposed Texas GulfLink deepwater port is not technically feasible from an enforcement standpoint, nor is it economically feasible. The proposed Texas GulfLink deepwater port, therefore, will operate under a specific facility design, work practices and operational standards that produce the maximum degree of HAP emission control achievable in practice. 40 CFR § 63.43(d)(3).

7.0 References

American Bureau of Shipping (January 2019), Rules for Building and Classing Single Point Moorings. https://ww2.eagle.org/content/dam/eagle/rules-and-guides/current/offshore/8-single-point-moorings/spm-rules-jan-19.pdf

Delaware Department of Natural Resources and Environmental Control Division of Air Quality. Regulation No. 1124, Control of Volatile Organic Compound Emissions. http://regulations.delaware.gov/AdminCode/title7/1000/1100/1124.shtml

Marine Environment Protection Committee (2009), Guidelines for the Development of a VOC Management Plan, Resolution MEPC.185(59), Annex 10. http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/185%2859%29.pdf

Oil Companies International Marine Forum, Singe Point Mooring Operational and Maintenance Guide 3rd Edition, 2015.

Oil Companies International Marine Forum (2019), Volatile Organic Compound Emssions from Cargo Systems on Oil Tankers 1st Edition. https://www.ocimf.org/media/115782/Volatile-Organic-Compound-Emissions-from-Cargo-Systems-on-Oil-Tankers.pdf

Rudd, Howard J and Hill, Nikolas A (2001) Measures to Reduce Emissions of VOCs during Loading and Unloading of Ships in the EU, AEAT/ENV/R/0469, Issue 2. https://ec.europa.eu/environment/archives/air/pdf/vocloading.pdf

TCEQ (2014) Emissions Calculation Spreadsheet. https://www.tceq.texas.gov/assets/public/permitting/air/NewSourceReview/oilgas/spreadsheet-revisions.pdf

USCG (2019) Marine Vapor Control Systems. Facility requirements for vessel vapor overpressure and vacuum protection. https://www.ecfr.gov/cgi-bin/text-idx?SID=981082a7e3eaf86ba2ecbf418ad59b5f&mc=true&node=se33.2.154_12103&rgn=div8

USCG (2019) Vapor Control Systems. Operational requirements for vapor control systems during cargo transfer. https://www.ecfr.gov/cgi-bin/text-idx?SID=93b293f0d06ff94e2d48314fa4cadf3e&mc=true&node=pt46.1.39&rgn=div5#se46.1.39_13001

8.0 Attachments

The following information is included in this section:

1. Figure 1 – Project Location Map
2. Figure 2 – Texas GulfLink Crude Oil Pipelines and Hoses – Deepwater Port Design
3. Figure 3 – Maneuvering Area Safety Buffer
4. Figure 4 – Vapor Recovery Profile (Technical Issues)
5. Figure 5 - Example Crude Oil Flash Gas Composition
6. Figure 6 – Vapor Recovery Line Profile
7. Figure 7 – Cargo Tank Pressure Chart
8. Figure 8 --Terminal Geographic Location Reference
9. Figure 9 -- Table 2-4 Summary of Criteria and GHG PTE Rates for DWP Facility
10. Figure 10 – Louisiana Offshore Oil Port 2009 AIS Tracks

FIGURE 1 - Project Location Map

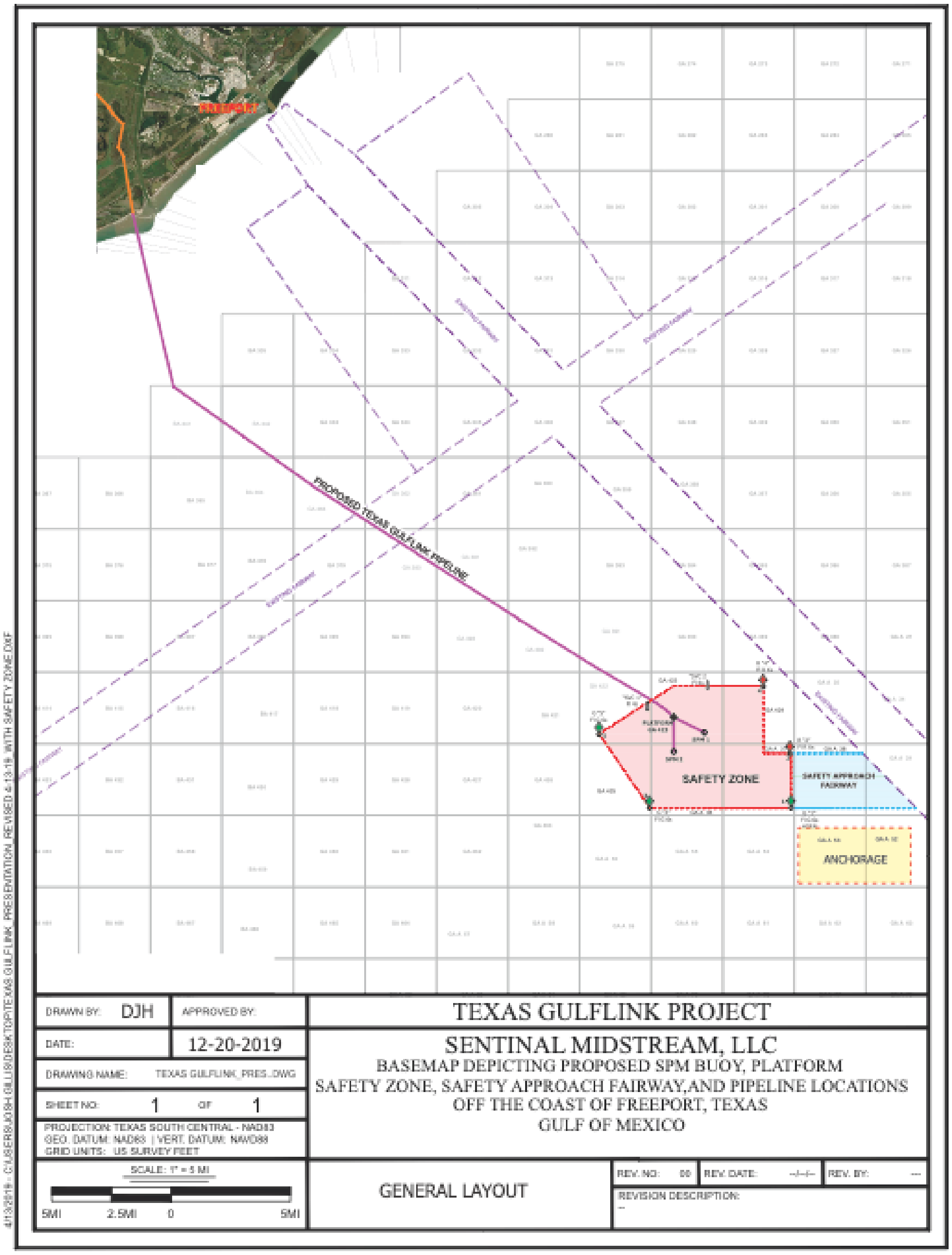


FIGURE 2 - Texas GulfLink Crude Oil Pipelines and Hoses - DWP

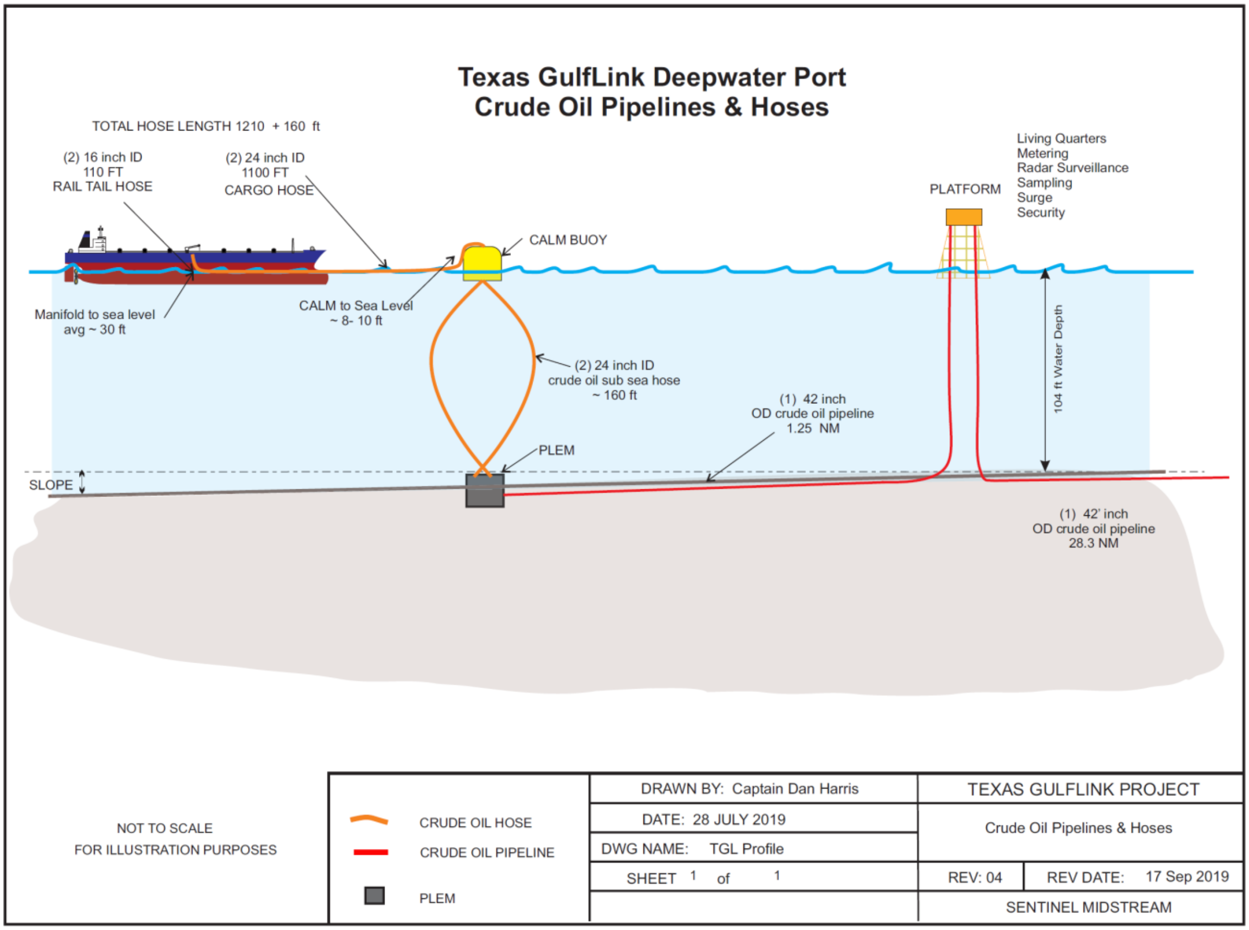


FIGURE 3 - Maneuvering Area Safety Buffer

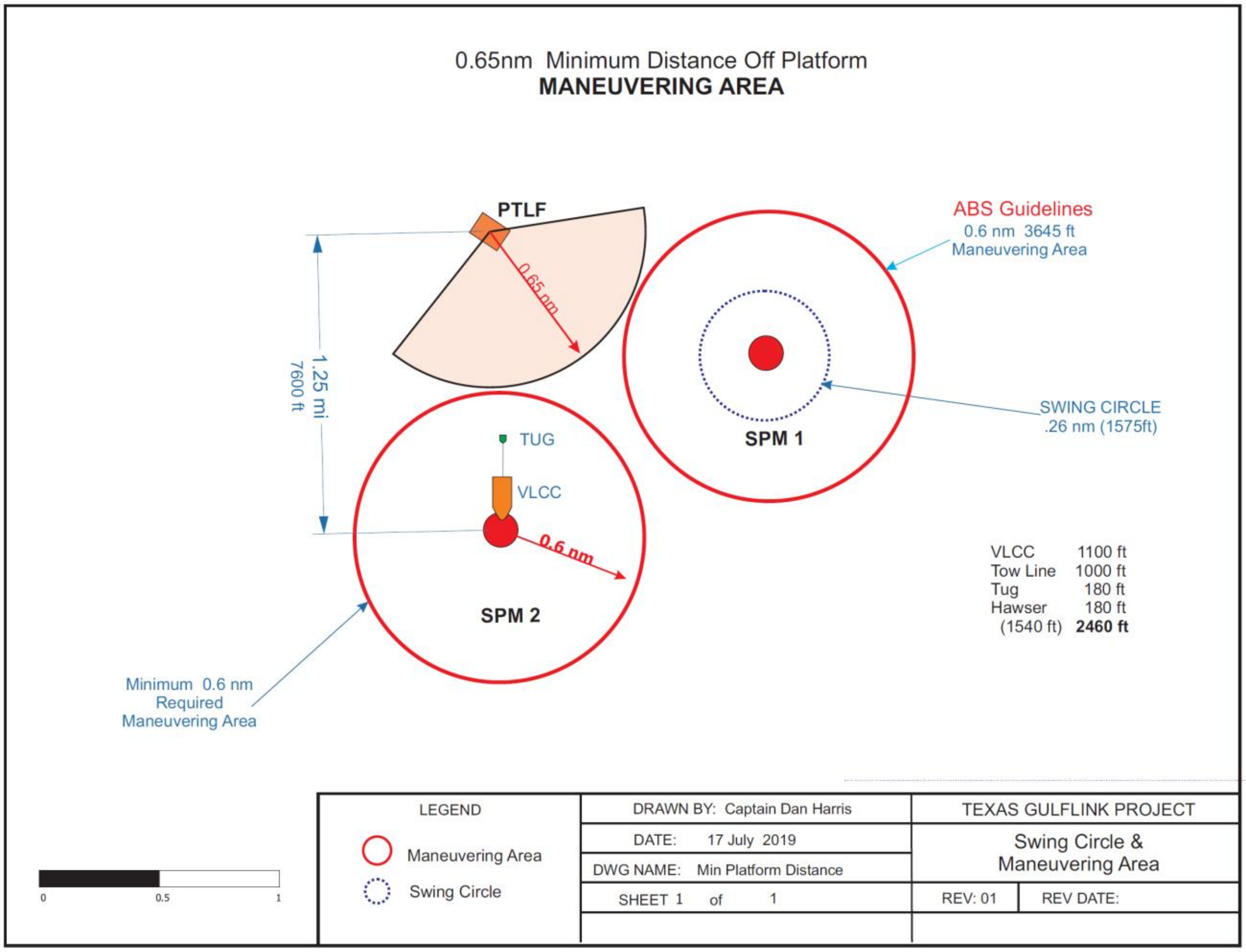
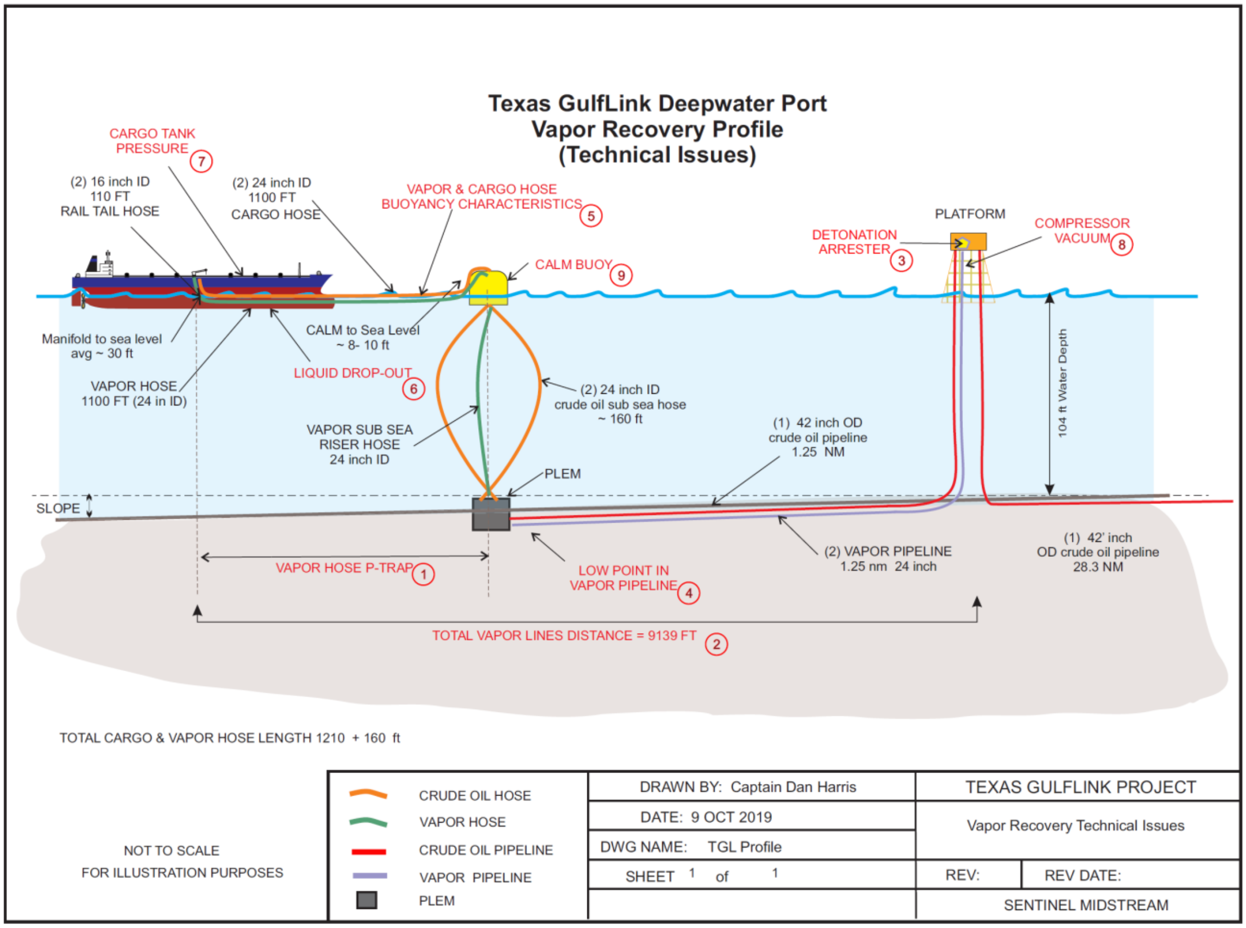


FIGURE 4 - Vapor Recovery Profile Technical Issues



1. P- Trap between tanker manifold and Calm Buoy
2. Vapor Line - Engineering challenge to recovery vapors at 9139 ft vapor line
3. Detonation Arrestor Location beyond 59 ft 33CFR154.2195 requirement
4. Low point in Vapor Pipeline from Platform to PLEM
5. Floati**ng** Vapor Hoses, issues with liquid drop-out, kinking, and vacuum
6. Liquid drop-out issues with measurement, draining, and blockage
7. Cargo Tank Pressure issues with vapor flow restriction and pressure spikes
8. Compressor Vacuum required to over come pressure drop of 9139 ft line.
9. Propane use on manned platform

FIGURE 5 - Example Crude Oil Flash Gas

GOR Calculator

This table can be used to calculate the flash gas molecular weight and the component weight percents if needed, if the flash gas mole percents are entered. It can also calculate the overall VOC, benzene, and H2S flash emissions if the GOR and the oil/condensate throughput are entered.

Gas Oil Ratio:	19.1	in standard cubic feet of flash gas per barrel (SCF/bbl) of oil/condensate produced
Barrels of Oil or Condensate per day:	4500	

Flash Gas Speciation:					Flash Gas MW =	34.729702
Component	**mole %**	Molecular Weight (grams/mole, lb/lb-mol)	grams per 100 moles of gas	**weight %**		
hydrogen		2.01588	0	0.0000	Total gas emitted:	
helium		4.0026	0	0.0000	lb/hr:	327.750333
nitrogen	0.7970	28.01340	22	0.6429	tpy:	1435.54646
CO2	0.7520	44.00950	33	0.9529		
H2S	0.0010	34.08188	0	0.0010	VOC wt% =	64.6025
methane (C1)	37.8800	16.04246	608	17.4977		
ethane (C2)	18.8300	30.06904	566	16.3030	VOC, lb/hr:	211.734938
propane (C3)	23.5040	44.09562	1036	29.8426	VOC, tpy:	927.39903
butanes (C4)	11.2060	58.12220	651	18.7539		
pentanes (C5)	4.4450	72.14878	321	9.2342	Benzene wt% =	0.1304
benzene	0.0580	78.110000	5	0.1304		
other hexanes (C6)	1.7250	86.18000	149	4.2805	Benzene, lb/hr:	0.42753996
toluene	0.0220	92.140000	2	0.0584	Benzene, tpy:	1.87262504
other heptanes (C7)	0.6640	100.20000	67	1.9157		
ethylbenzene	0.0010	106.170000	0	0.0031	H_2S wt% =	0.0010
xylenes (o, m, p)	0.0010	106.170000	0	0.0031		
other octanes (C8)	0.1090	114.23000	12	0.3585	H_2S, lb/hr:	0.00321637
nonanes (C9)	0.0060	128.26000	1	0.0222	H_2S, tpy:	0.01408769
decanes plus (C10+)			0	0.0000		
Totals:	100.0010	34.73	3473	100.00		

Figure 6 - Vapor Recovery Profile

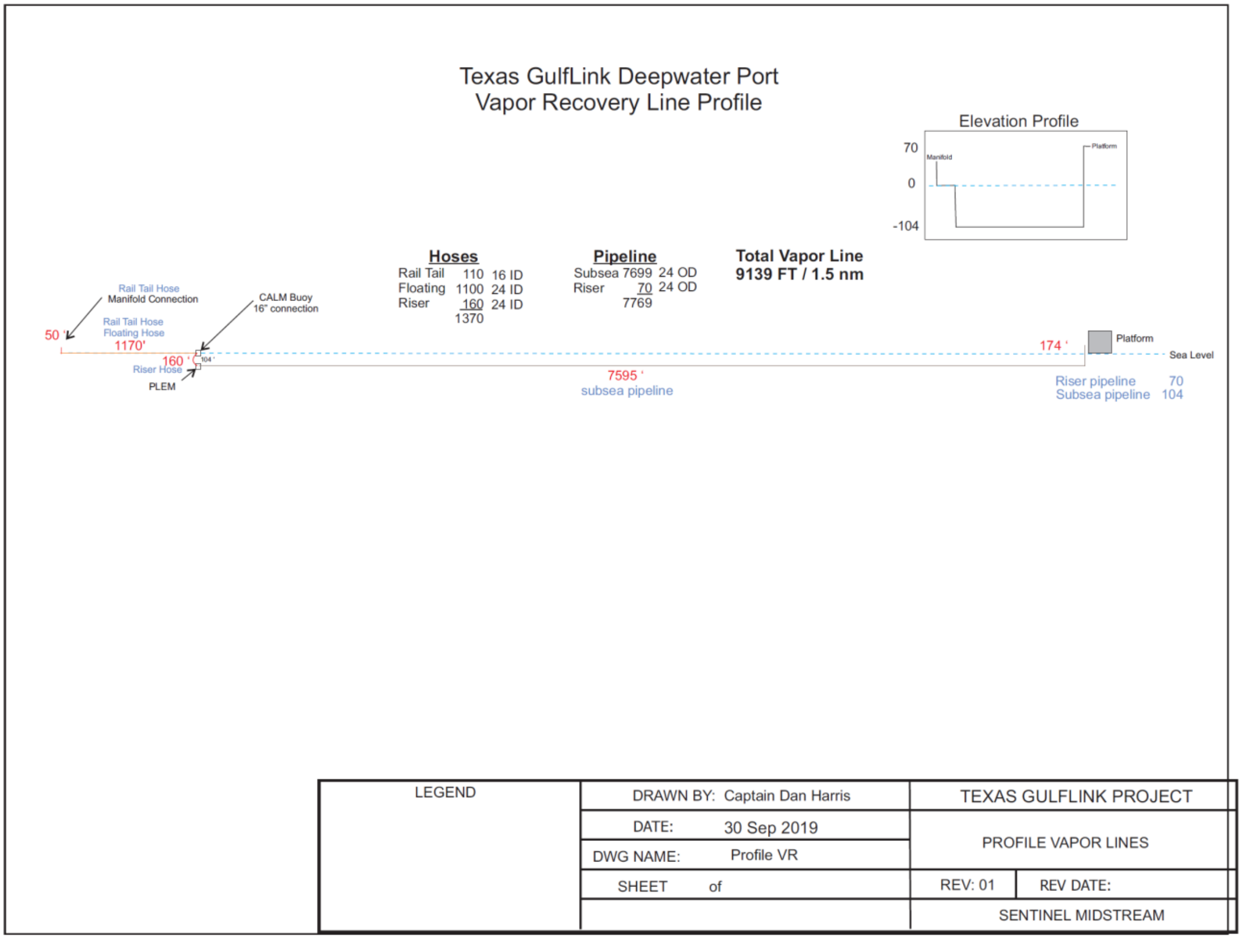
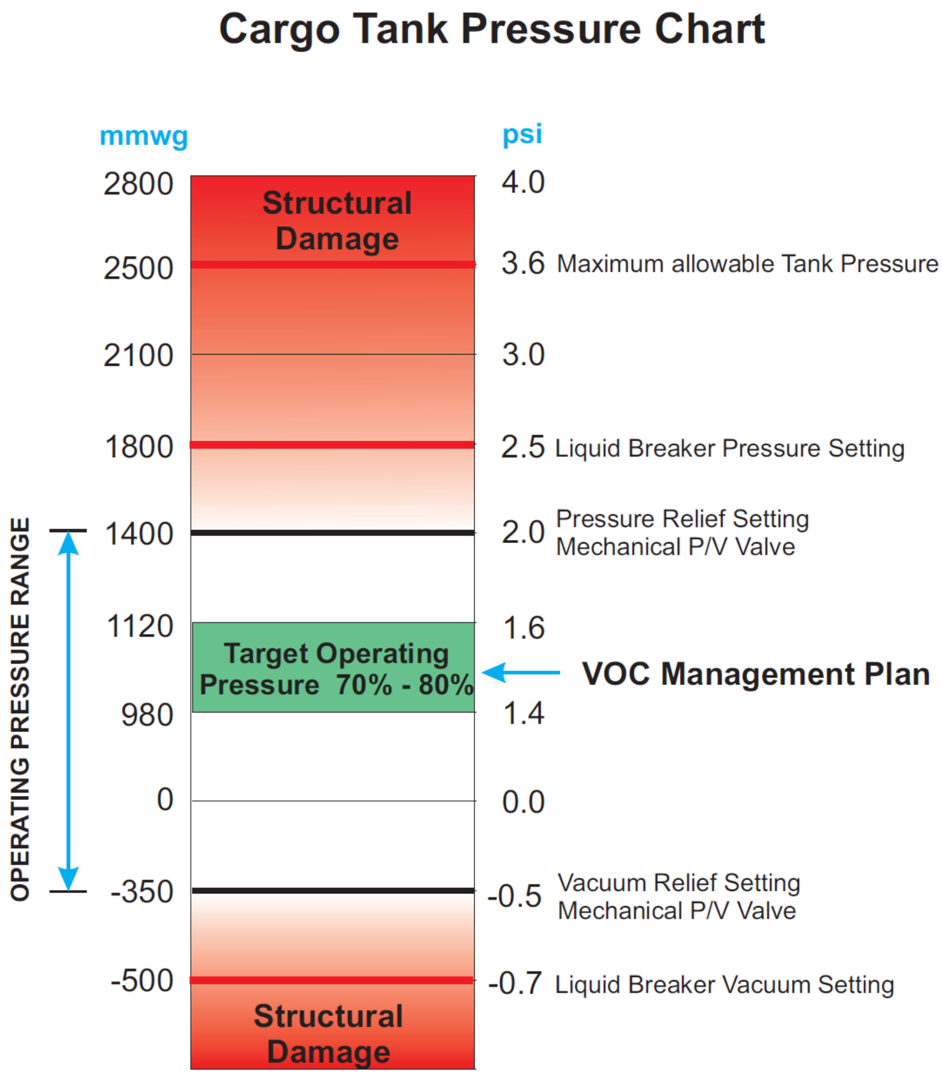


FIGURE 7 - Cargo Tank Pressure Chart



- 0.7 psi Liquid Breaker operates allowing uncontrolled intake of fresh air into all tanks

- 0.5 psi Individual P/V Valves lift allowing fresh air intake into individual tanks

2.0 psi Individual P/V Valves lift releasing hydrocarbon vapors on deck

2.5 psi Liquid Breaker operates allowing uncontrolled release of hydrocarbon vapors from all tanks

3.6 psi The typical maximum allowable ullage pressure in a standard tanker

- 0.5→ 2.0 psi System Operating Range

FIGURE 8 - Terminal Geographic Location Reference

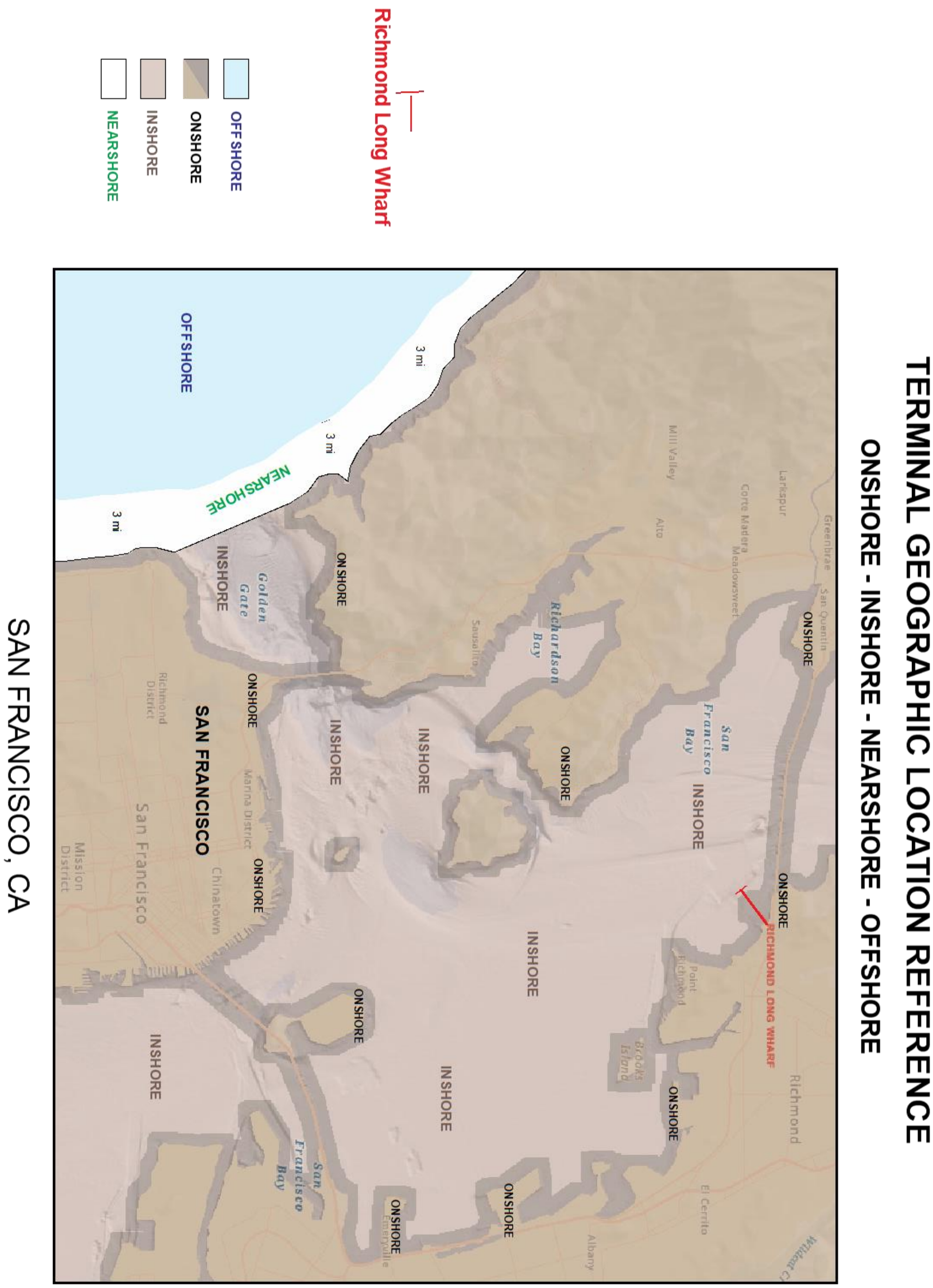


FIGURE 9 - Table 2-4 Summary of Criteria and GHG PTE Rates for DWP Facility

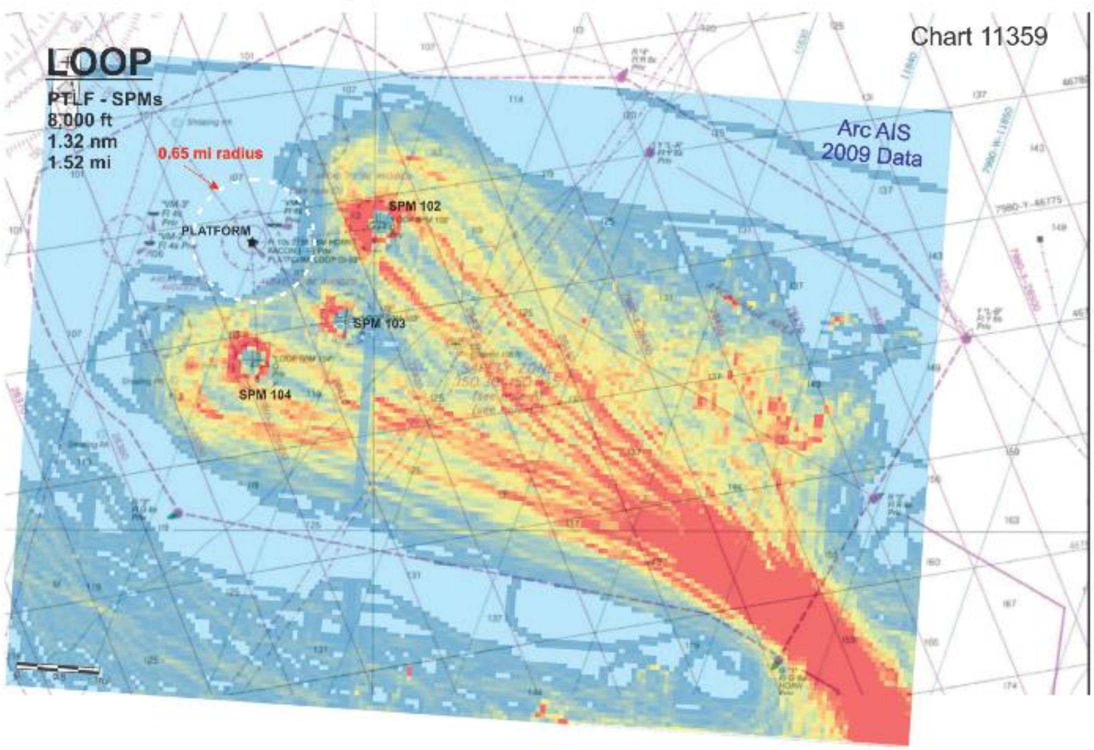
EPN	Source	H_2S		Acetaldehyde		Benzene		Isopropylbenzene		Ethylbenzene		Formaldehyde		Hexane (-n)		2,2,4-Trimethylpentane (isooctane)		Toluene		Xylene (-m)	
		(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
(S) M-1	Marine Loading	0.12	0.05			20.78	42.70	0.16	0.33	1.39	2.86			107.53	220.99	1.79	3.67	10.17	20.90	4.08	8.38
(P) G-1	Generator 1			0.0002	0.001	0.01	0.02					0.001	0.002					0.002	0.01	0.002	0.01
(P) G-2	Generator 2			0.0002	0.001	0.01	0.02					0.001	0.002					0.002	0.01	0.002	0.01
(P) C-1	Crane 1											0.004	0.02								
(P) DT-1	Day Tank 1																				
(P) BT-1	Belly Tank 1																				
(P) BT-2	Belly Tank 2																				
(P) BT-3	Belly Tank 3																				
(P) BT-4	Belly Tank 4																				
(P) T-1	Surge Tank					0.002	0.01			0.0001	0.001			0.01	0.04			0.001	0.004	0.0003	0.002
(P) FWP-1	MSS - Firewater Pump																				
(P) P-1	MSS - Pigging Operations					0.37	0.002							1.91	0.01			0.18	0.001		
(P) F-1	Platform Fugitive Emissions						0.0007062							0.0005	0.002				0.001177	0.0004	0.002
(S) F-2	SPM System Fugitives																				
(P) S-1	Sampling Activities																				
(P) PM-1	MSS - Pump Maintenance																				
(P) MSS-1	MSS - Abrasive Blasting / Painting																				
TOTAL EMISSIONS (TPY)		0.12	0.05	0.0003	0.001	21.16	42.75	0.16	0.33	1.39	2.86	0.005	0.02	109.45	221.04	1.79	3.67	10.36	20.92	4.08	8.39

FIGURE 10 – LOOP's 2009 AIS Tracks

Vessels traveling in U.S. coastal and inland waters frequently use Automatic Identification Systems (AIS) for navigation safety. The U.S. Coast Guard collects AIS records using shore-side antennas. These records have been filtered and converted from a series of points to a set of track lines, and then summarized at a 100 m grid cell resolution. A single transit is counted each time a vessel track passes through, starts, or stops within a grid cell. This layer is depicting transits attributed to tanker vessels

MARINE CADASTRE.GOV Arc GIS Data

Overlay 2009 USCG AIS data on Chart 11359



Note that several AIS tracks would have resulted in platform strikes at LOOP when considering the 0.65 maneuvering criteria used by SPOT. The yellow track lines (multiple runs) are extremely close as well. This is a good slide presentation to challenge the 0.65 distance in actual LOOP operations.

SENTINEL MIDSTREAM

TEXAS GulfLink

The signature below confirms that I have knowledge of the facts included in this application and that these facts are true and correct to the best of my knowledge and belief.

I am authorized to sign as an agent of Texas GulfLink and Sentinel Midstream for the proposed Texas GulfLink Deepwater Port.

X ______________________

Tyler M. Abadie, P.E.
Texas Gulflink
Deepwater Port Licensing Lead

STATE OF TEXAS
TYLER M. ABADIE
132953
LICENSED
PROFESSIONAL ENGINEER

1-7-2020

Sworn and subscribed to me, the undersigned Notary Public, this 7th day of January, 2020, in the Parish of Jefferson.

____
Tod J. Everage

TOD JOSEPH EVERAGE
NOTARY PUBLIC No. 89443
State of Louisiana
My Commission is for Life

My commission expires at death.